This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Soc 18855 c.30
1857-73

3 pamphlets at end are [illegible]
catalogued

Soc 18855 c.30

1857-73

3 pamphlets at end of volume
catalogued

PRESENTED
BY
THE HOPE PROFESSOR
OF ZOOLOGY
22:3:46

REPORT

OF THE

RUGBY SCHOOL NATURAL HISTORY SOCIETY,

FOR THE YEAR 1867.

MAR 22 1946

"IIS, QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."—*Bacon.*

RUGBY:
W. I. TAIT AND SONS, ALBERT STREET.
1868.

PREFACE.

SOME apology may be due from our Society for thrusting itself so soon upon the public. Our Society, as the one product of the Tercentenary Year already in existence, is desirous of making known what it is doing. Its members have for their objects—(1.) to combine together to work out the Natural History of Rugby; (2.) to keep an Annual Register of all the facts connected with Natural History observed here; (3.) to assist in the formation of a Museum for reference; (4.) to hold Meetings where Papers may be read by ourselves or our friends. In carrying out this scheme we have, of course, only partly succeeded. A List of Fossils* from the Rugby Lias has been compiled from the Arnold Library Collection and from other sources; first lists of the Birds† and Lepidoptera‡ of the neighbourhood have been prepared by ourselves, supplemented by any older records available; and a Register of Dates§ during the year has been kept,—not, indeed, with the systematic completeness at which we aim, but if Rome was not built in a day, how much less the R. S. N. H. S.?

Towards our third object not much has been done. The School possesses, independently of us, good Geological and Botanical Collections; but, as yet, there is no Museum by means of which the Collector of insects or birds may name his doubtful specimens. Help has been given by Messrs. HAYWARD and WRATISLAW,‖ but till we possess a local habitation somewhat less gloomy than the Sixth School gallery, somewhat more independent than our President's study,[*] we cannot be expected fully to develop our powers of acquisition.

---

* Page 55. † Page 52. ‡ Page 39. § Page 45. ‖ Page 88.

Our Meetings are attended by increasing numbers, and some of the papers read at them have, from their local interest, seemed worthy of a permanent record.

We record our thanks to our several benefactors,[†] and especially to Mr. Wilson, for presenting the Members with tickets of admission to his lecture on "The Meteors."

And now we leave our Report to speak for itself. If any find fault with what we have done, let them come and teach us to do better. We still—though our numbers are steadily increasing—find the work of observation more than we can really carry out. If any one is interested in this our Society, let him honour us with a visit, and then, if he have a good pair of eyes, two good legs, and a hearty will to use them, we will soon find some way to avail ourselves of his services. We do not hold out any sensational promises: it is only by the continuous accurate accumulation of facts that our Society may hope to contribute to scientific knowledge.

F. E. K.
H. C. L. R.
E. C.

---

[*] Where the Members may at present consult the Library and Collections on Mondays, Tuesdays and Thursdays, between Two and Six p.m.

[†] Page 8.

RULES.

1. That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

2. That the Society consist of Honorary Members, Members, and Associates.

3. That Masters, Old Rugbeians, and others connected with the School, be eligible as Honorary Members; that Present Rugbeians (having attended as a visitor three of the Society's meetings) be eligible—if in the Upper School or Sixth, as Members, if in the Middle or Lower School, as Associates.

OF OFFICERS:—

4. That the Society's Officers consist of a President, Secretary, and Treasurer, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

5. That all Officers be elected annually.

6. That, when any Office is vacant, the Committee do recommend a Member or (for the Office of President) an Honorary Member, for election by the Members of the Society.

7. That the President take the chair at all Meetings, but have no vote except in cases of equality.

8. That the Secretary keep the Minutes of the Society's proceedings; keep a list of all persons present at each Meeting; keep a list of the existing Society, with the names and addresses, as far as possible, of all non-resident Members, and a list of all Benefactors of the Society.

9. That the Treasurer look after the Property of the Society, collect Subscriptions, and pay Debts, producing his accounts for inspection whenever called upon by the President to do so.

10. That the duty of the several Album Keepers be to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Sections during the year.

11. That in the absence of any Officer, the Committee appoint a Deputy.

OF HONORARY MEMBERS:—

12. That Honorary Members be elected by a vote of the Society, and have all the privileges of Members, except that of voting.

13. That Honorary Members pay an entrance fee of 10s., but pay no subscriptions unless specially called upon.

14. That Members or Associates, on leaving the School, become Honorary Members, without any charge, except for a supply of the Society's Reports.

OF MEMBERS AND ASSOCIATES:—

15. That Members be proposed by a Member or Honorary Member, and elected by the Committee.

16. That Members pay a Subscription of 2s. 6d. per Term, and Associates of 1s. 6d. per Term.

17. That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce two visitors at all public meetings, and receive a copy of the Society's Report.

18. That Associates may attend at all public meetings; may speak, and read papers with the leave of the President; and receive a copy of the Society's Report.

19. That any Member or Associate may be suspended or expelled from the Society, by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

OF MEETINGS :—

20. That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

21. That Visitors may speak and read Papers at all public meetings, with the leave of the President.

OF REPORTS :—

22. That a Report be printed once a year, or oftener if the Committee think fit.

23. That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

OF NEW RULES :—

24. That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any name be submitted to the Committee for Membership or Association.

25. That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

LIST OF THE EXISTING SOCIETY.

OFFICERS FOR 1867:

President: MR. F. E. KITCHENER.
Secretary: G. B. LONGSTAFF.
Treasurers: J. S. MASTERMAN.
W. C. MARSHALL.

Album Keepers:
Botanical: H. C. L. READER.
Geological: A. C. BRUCE.
Entomological: G. B. LONGSTAFF.
Zoological: F. C. SELOUS.

Editors: E. CLEMINSHAW, and H. C. L. READER.

HONORARY MEMBERS:

- DR. HELM.
- REV. T. N. HUTCHINSON.
- MR. KITCHENER.
- MR. SIDGWICK.
- REV. C. J. E. SMITH.
- MR. WILSON.

NON-RESIDENT MEMBERS:

- A. C. BRUCE.
- E. P. KNUBLEY.
- P. MAHONY.
- W. C. MARSHALL.

MEMBERS:

- E. CLEMINSHAW.
- G. B. LONGSTAFF.
- J. S. MASTERMAN.
- H. C. L. READER.
- F. C. SELOUS.
- A. S. SCOTT.
- J. H. DAVIES.
- J. LAWE.
- J. M. LESTER.
- J. P. BAYNES.
- M. W. E. DE BUNSEN.
- F. LEFROY.
- E. J. NORTON.
- W. H. PIKE.
- H. G. WAUTON.

ASSOCIATES:

- F. R. SMITH.
- W. SUTCLIFFE.
- E. W. PREVOST.
- J. ARMITAGE.
- J. CURRY.
- F. C. BAYARD.
- J. L. BOYSON.
- L. MOBERLY.
- O. LEGGATT.

PRINCIPAL DONATIONS MADE TO THE SOCIETY.

Case of Rugby Lepidoptera, by Mr. Wilson.

Schleiden's *Botany*, and Kirby and Spence's *Entomology* (4 vols.), by the President.

Photographs of Limeworks at Newbold, and Sections of Artesian Well, by Mr. Wilson.

The Prize Collection of Plants in 1862, by Mr. H. W. Sneyd Kynnersley.

Water Colour Sketches of Flamborough Head, Newbold Lime Pits, and Glacier-rounded Rocks at Grange, Cumberland, painted by himself, by W. C. Marshall.

Photographs of Mount Sorrel Granite Quarries, by Mr. Hamblin.

Palæontologica Indica, and *Memoirs of the Geological Survey of India*, by Dr. Oldham.

Collection of Rhopalocera and Sphinges, by Rev. J. Hayward.

Two Cases of Indian Insects, by E. J. Norton.

Collection of Warwickshire Eggs, by E. Field.

Linnean Society's Journal (Botany, Vols. 5 to 9), and *Annals of Natural History* (Vols. 11 to 19), by Mr. G. E. Fryer.

LIST OF PERIODICALS.

Quarterly Journal of the Geological Society; Geological Magazine; Quarterly Journal of Science; lent by Mr. Wilson.

Popular Science Review; Journal of the Linnean Society; lent by the President.

Hardwicke's Science Gossip.

MINUTES OF MEETINGS.

MEETING HELD MARCH 23RD, 1867.

THE SOCIETY was founded, and Rules drawn up.

A Paper on the Purposes of the Society was read by Mr. F. E. KITCHENER.

Nine persons were present.

MEETING HELD MARCH 30TH, 1867.

THE Exhibitions were

Belemnites elongatus, with phragmacone, from Hillmorton, and from Kilsby; and *Discina Holdeni* on *Ammonites angulatus*, from Newbold, by E. CLEMINSHAW.

Curious growths of stem in *Wistaria* and other plants, by Mr. F. E. KITCHENER.

Coleoptera of the present year, by G. B. LONGSTAFF.

Mole Crickets, by P. MAHONY.

After the Exhibitions a Paper was read by G. B. LONGSTAFF —"On Insects: their Collection and Preservation." This Paper was illustrated by Specimens and Apparatus.

I. LEPIDOPTERA.

For the Collection of Lepidoptera, or scale wings (butterflies and moths) the following apparatus is required:—(1.) A pocket net, with a ring capable of being placed round the collector's waist, fitting into a jointed stick. Such a ring may be got at Porter's, Lawrence Sheriffe Street; the stick and gauze at Pendred's, North Street; or an umbrella net, to be got complete at Cooke's, Oxford Street, London. (2.) About 12 dozen pill boxes of various sizes, especially the 1 oz. and ½ oz. size. (3.) A setting house, containing a number of setting boards, on which the insects are to be spread. (These are also sold by Cooke.) (4.) Thin pins of various sizes (Nos. 18, 7, 8, 10, and 20, sold by Edelsten and Williams, Newhall Works, Birmingham). (5.) A large jar, with screw top and wide mouth, to contain bruised laurel leaves. A French plum jar will answer the purpose. The bruised laurel leaves are to kill the insects, but in spring and autumn they do not contain enough prussic acid for the purpose. At these seasons chloroform may be used thus: Almost open the box, and put a drop of chloroform on the slit; then close the box tightly, and leave it for about three minutes. This will suffice for smaller moths and butterflies. The larger ones should be probed with a pen containing a portion of saturated solution of oxalic acid. (6.) Stanton's *Manual of British Butterflies and Moths* (price 10s. 6d.), and Greene's *Insect Hunter's Companion* (price 1s. 6d.). Both these are indispensable.

When you have caught your insects with your net, put them alive into the pill-boxes, one in each box, bring them home, and then put them into the laurel-jar, boxes and all. In a few hours you will find your insects in a suitable state for setting.

The best localities at Rugby for Lepidoptera are Frankton Wood (especially the lanes between Frankton and Bourton), and the "twelve-o'clock riding" at Coombe Abbey. Railway banks, again, are sometimes very productive.

II. COLLECTION OF COLEOPTERA AND HEMIPTERA.

On the collection of these two classes (the case-wings or beetles, and the half-wings or bugs), valuable Papers will be found in the *Entomologists' Annuals (Van Voorst)* for 1855 and 1862 respectively.

A net is required for both of these classes which may be used in the water and for sweeping the herbage. I know of none sufficiently strong and at the same time portable. The ring should be made of very thick wire, let into a lump of lead, which may be fastened by means of screws into a brass socket at the end of a long stout pole. The net itself must be of stout cheese-cloth, or better still, of bolting-cloth used for flour. Besides this, one or two brass bottles are required, fitted with a cork through which passes a rather long quill stopped with a plug of wood. This bottle should be filled two-thirds full with finely cut up and crushed laurel leaves. The larger beetles may be put in by removing the cork, the smaller ones through the quill.

When the insect is once corked up, it will soon be stupified, and, if a small one, killed. After the return home these bottles should be immersed up to the neck in boiling water for two or three minutes, to insure the death of the inmates. Mr. Blackburn recommends the smaller beetles being brought home alive in a bottle containing pieces of blotting paper for them to cling to, and from which they may be afterwards shaken into boiling water.

The insects of these two orders are set out on card by means of needles, and, where necessary, a magnifying glass. To the card they are attached with gum consisting of the purest white lumps of Tragacanth, mixed with a little of the purest Arabic. Not more than a liquid ounce of this gum should be made at one time, or it will get dirty; it should be very thick, and with each bottle of it a drop of corrosive sublimate should be mixed. All Hemiptera must be arranged on cards; the larger Coleoptera may be pinned.

For those who are going to collect beetles Rye's *British Beetles* is strongly recommended.

The following are the chief methods of finding beetles and Hemiptera:—(1.) By dragging ponds and streams with a net. (2.) By overturning large stones and logs. (3.) By tearing loose bark off trees and logs. (4.) By beating flowers, brushes, and trees into an umbrella. (5.) By sweeping grass and herbage with a net, by night as well as by day. (6.) By shaking over brown paper

moss, tufts of grass, rubbish at the roots of trees, and the old hay left where a stack has been.

To all specimens a number should be attached, referring to a Diary: The Diary should be ruled into six columns—Index-No. ; Date ; No. taken ; Name ; How got ; Locality, &c.—and the entries would perhaps run—

"268a. ; iv. 29 (*i. e.*, April 29) ; One ; *Eucheiia Jacobææ ;* Bred from larva on ragwort, 1866 ; Lyndhurst, Hants."

The numbers which refer to the Diary may be written, in the case of insects pasted on cards, on the cards themselves ; and in the case of pinned insects, on the small piece of paper on the same pin as the insect, face downwards.

This was followed by a Paper by A. S. SCOTT, "On Local Nomenclature."

In all 24 Persons were present.

MEETING HELD APRIL 18TH, 1867.

THE following Objects were exhibited :—

Ammonites Birchii and *Modiola*, from Hillmorton ; *Ammonites angulatus*, from New Bilton ; and Vertebra of Icthyosaurus from Newbold ; by P. MAHONY.

Bones and Teeth of *Pleistocene* or recent *Mammalia*, from river Gravel, near Newton, by E. CLEMINSHAW.

Nests of Baya Sparrow and of Tailor Bird from India, by Mr. J. M. WILSON.

Eggs of this year, by F. C. SELOUS.

Crystals of Gallate of Iron in an old inkstand, by F. R. SMITH.

Daphne Laureola (new), and Snowdrop (escaped), from Rugby, by H. C. READER.

A paper was then read by J. M. WILSON, ESQ., "On the Objects of the Geological Section of the Natural History Society."

As there exists a Geological Section to this Society, and as many members are much interested in this branch of study, it may be worth while to consider what ought to be the objects at which a Society of this kind should aim in establishing a Geological Section, and to offer some suggestions as to the method of attaining them.

For our purpose we may divide the study into that of General Geology and Local Geology.—It is not likely that any of us will be able to write papers on General Geology, that shall be at the same time interesting to the members of the society, present or future, and in themselves valuable; but there is much that can be done to render the study of General Geology more accessible to the School. This will be done by the contributions of fossils of real value, such as illustrate some special point in structure, some remarkable instance of fossilization, some typical character.* And again, rock specimens and minerals are absolutely necessary to the proper study of the science, and are used in our lectures. It will constantly be within the power of members of the society to obtain and exhibit such specimens at our meetings, and perhaps some may be willing to leave memorials of themselves behind them, in the shape of presents to the Geological Museum.+

Further, few things are more useful in studying Geology than a portfolio of sketches and photographs, that depict those peculiarities of scenery that depend directly on Geological structure. They should have written on them an account of what is actually exhibited by them. Such a Geological portfolio already has been started, and may well be enriched by sketches and photographs of objects of Geological interest in the various parts of England to which, through its members, this Society has access. ‡

Again, anatomical illustrations are constantly wanted. Nothing would be more interesting as an exhibition, or more valuable as a contribution, than skeletons of some of the typical mammalia for comparison with fossil remains, and by which to determine our fossil species from the river deposits.

But the principal work of the Geological Section ought to be the Local Geology. In this there is a vast amount of real work to be done, far more than we can yet foresee, and it is our privilege and honour, as the founders of this Society, to map out the outlines of what ought to be done, to contribute what we can, and we must wait for others to come in and complete our labours. It is hard for you to estimate the slowness with which Geological knowledge is accumulated; and knowing as we do how seriously error retards even this slow progress, we must aim at least at making our contributions to this knowledge as correct as we possibly can. Let our work be unpretending, but let it be unimpeachable. To accept anything on insufficient evidence, and report it as proved, is sure to retard the progress of true knowledge and disgrace us in the end. *Qui facile credit, idem libenter decipit.* On such a subject as this we must aim at co-operation with our successors: no single generation can complete the subject.

I shall proceed now to make some brief remarks on the principal subjects that occur to me, connected with the Local Geology, on which I hope to see papers contributed, and which are really within our power to treat in such a manner as to form a permanently valuable contribution to Geological Science.

---

* C. S. Taylor, Esq., has since contributed a few valuable specimens, and promised more.

+ In rock specimens the Museum is tolerably rich.

‡ Mr. W. C. Marshall has made some valuable additions to the Portfolio. They will be described in detail further on.

The Geology here offers two entirely distinct subjects for study, viz., the surface and surface deposits, and the subjacent strata.

For the former it is most desirable that accurate information should be obtained and published respecting the form of the surface and the country; the relative and absolute elevations of it, and in fact all the information that would be required for constructing a model of this country in relief. Few things would be of more service than the construction of such a model. If any member would provide himself with a very accurate aneroid barometer and compass, by repeated observation, the levels of a number of selected spots with some standard spot, as the School gates, whose elevation above the sea is known to a tenth of an inch, he would be contributing information which will some day be of great service. Secondly, observations on the *amount* of Geological changes now going on around us are much wanted, here and in all localities. Year by year we see the river overflow its banks, and spread itself far and wide over the meadows. In so doing it spreads a thin deposit of sediment over the grass and surface, and raises the level of the valley. Now if some one will be at the pains very carefully to estimate the amount of this sediment, whether by direct or indirect measurement, and record the circumstances and details of his measurement, he will be contributing his mite towards the solution of the great problem of the antiquity of the present outlines of our hills and valleys. The changes of the windings of the brooks we all know so well are very instructive. We see there in part what may be seen in all rivers that flow through flat countries on a large scale. If any such changes occur let them be recorded. Thirdly, the nature of the surface deposits offer an inexhaustible field for study. The deposits here are marked in the Geological survey as "drift sand and gravel;" but we must examine this broad assertion as it were with a microscope, and keep a permanent record of the localities and the boundaries of these sands and gravels. There are sand beds for example between the Bilton and Lawford Roads; and at Hillmorton, and on the bridle road to Barby, on the slope of the hill this side Rainsbrook, and on the way to the butts. The influence of the sand on agriculture is a curious subject to trace. The passage from alluvial deposits to sand is marked out by the cessation of grass fields and the appearance of corn land. Wherever it is possible let accurate records be kept of the thickness of the gravel deposits. Even in the pits now open it would be well worth while to measure, and to communicate in a written form to the Geological Section, the thickness of the gravel. If it is not measured the progress of the pits will soon make it impossible for it to be measured. The presence or absence of pools of water in the fields, the aspect of the ditches, the character of the footpaths and fields, will give some information as to the nature of the surface deposits, when more reliable sources are inaccessible. And whatever is ascertained let it be recorded for our successors. It may serve in the hands of some one to demonstrate the nature and direction of the currents by which the drift was deposited. Fourthly, the composition of the drift. This is so extensive a subject that I scarcely know how to write briefly about it. There appears here to be the mixture of two totally distinct drifts, which we may call the northern and eastern drifts. Where they came from, how and when they came, what are their limits, how far they are contemporaneous or successive, whether they have been subsequently submerged and mixed, are all points of the highest interest, which can never be settled till more knowledge has been attained of facts. Contribute then, if you can, something to this. Find out the principal varieties of stones to be found in the drifts. Record what you find in various places. Note the proportion of sand to stones, of stones of the size of marbles and the size of eggs; and record the observations in the form of percentages as accurately as you can. In the same way distinguish between the well-rounded pebbles and the angular stones sometimes found. In the same way record the percentages of grits and sandstones, of flints, of varieties you cannot name. There are to be found in the drift at Brownsover blocks of chalk; at Hillmorton pieces of hard Eocene* (?) sandstone; and occasionally, though very seldom, crystalline rocks. Record especially the discovery of large erratic stones. Of such there are several within a few miles; notably on the Birmingham railway. Treasure any fossils you may find in the drift. Fifthly, record not only the composition but the arrangement of the drift. Make sketches or descriptions of the singular, the almost unparalleled, contortions of the drift at the New Bilton Pits; of the strange intermingling of clay and gravel. Remember that year by year these pits grow, and you may see and record what can never again be seen. Most welcome will such observations be to the Geological Portfolio which I present for the use of the Society. I dread encroaching too much on your patience, or I should speak of the study of the surface soil and its formation, of the stratified warp that here in some places underlies it; but I must at any rate call your attention, Sixthly, to the river gravels, which may be seen at Lawford Mill, and which fifty years ago yielded such magnificent spoils as the tusks of elephants, the head of a rhinoceros, the skeleton of the first hyæna discovered in England. To mark out the outlines of these river terraces, and notice their elevations above the river bed, will be really valuable work. They continue at intervals all down this valley, as at Stratford-on-Avon and various places on the banks of the Severn. They are totally distinct from the drifts. They are of river or lacustrine origin and not marine. An interesting fossiliferous gravel of this kind has been lately discovered by E. Cleminshaw, near the village of Newton. The banks also of the Avon, near Lawford Mill,† contain many bones. Seventhly, there are curious and instructive surface deposits here of an entirely different origin; I mean the deposits of glacial drift. They are to be found at Newbold, and Hungerfield near Brinklow, at Leir beyond Ullesthorpe, and probably at many places elsewhere. It is a wholly new subject here. What has been done already is nothing in comparison of what ought to be done in the elucidation of the contents, the mode of deposition, and the sources of these singular glacial drifts. They are marked by a general want of stratification, by stones foreign to the neighbourhood and quite unlike the general drift, by large angular blocks, and especially by striated and grooved stones. Possibly some of you may be more successful than I have been, and may find some shells. Such are some, and only some, of the points to which I wish to draw your attention as crying out for labourers in the geological field. I am well aware, however, that this is to many the least attractive part—measurements, drawings, records, percentages seem dry and uninteresting; but I cannot but express my conviction that this is by far the most promising field for discovery. The glacial deposits, for example, at Hungerfield, were discovered by two members of the School, J. W. Alexander and C. S. Taylor, having escaped the practised eyes employed on the Geological Survey. And this is a discovery of real value, that reflects the highest credit on them.

---

* This conjecture is due to the late well-known Geologist and Naturalist, Mr. H. E. Strickland, an Old Rugbeian, and perhaps the earliest Geologist in the School.

Leave to excavate must be asked for from C. M. Caldecott, Esq., of Holbrook Grange.

I must next point out as briefly as possible what kind of papers and notes on the lias, which forms the subjacent rocks, are likely to be of the greatest permanent value.

(1.) First, description of localities where the lias is exposed. The most valuable things you could contribute would be photographs* or sketches† of the lime quarries and clay pits. Such is the one of Newbold on the table, which was made for me five years ago by Charles Arnold. The rate of progress at the quarries is so great that some of the most remarkable sections in the Midland Counties are likely to be lost for ever unless our local Society preserves them. Records of the thickness of the bands of clay and limestone at Newbold and New Bilton might serve to establish a complete identity between the strata there exposed and similar strata elsewhere.

Secondly, the enumeration of the fossils found at each pit‡; and when possible the reference of them to some particular stratum. The pits and quarries differ largely in the fossils they contain. Up to the present time I believe no Saurian remains have been found at Hillmorton§, though they abound at New Bilton and Newbold. And the common Plagiostoma, if found at Hillmorton, would be the greatest of rarities. *Hippopodium ponderosum* has only just been discovered at Hillmorton, and has never been found elsewhere in this locality to my knowledge. For six years I looked in the pits here for *ammonites angulatus* in vain, and now I have found it at New Bilton, and Venables at Hillmorton. Facts of this kind will serve ultimately not only to establish the order of super-position of the strata here, which is already well ascertained, but will indicate whether any break exists in the series of forms of life; and will throw light on the continuity or the interruption of the deposition of sediment in the ancient Liassic Sea. This work can be assisted by the youngest and most inexperienced collector, and is the right door by which to enter on the study of this grand subject, Geology. A hammer, a keen observant eye, patience, and access to a well-arranged and catalogued Museum, are all that is necessary for the work.

Thirdly, we should aim at having an account of useful geological products of this neighbourhood. The Rugby limestone is of world-wide fame. We think of Rugby as the place of our School; thousands of our fellows associate the name of Rugby not with ideas of Latin and Greek, but with horse fairs and cattle fairs alone; and thousands more think of it only as some place in the country where the limestone is so excellent that it is worth while to send for the lime from all parts of England. At present the wonderful activity in the New Bilton and Newbold lime works is caused by the demand of lime for the Thames Embankment. So, too, our clay is largely used. We are on the borders of the new red sandstone, and the bricks are sent to considerable distances for building purposes; and the sand at Hillmorton is profitable to its owner. Other things we want, such as good gravel, and stone for mending the roads. I invite some member to contribute short notes on the hydraulic lime for mortar, on the new gravel terraces in the close, and the stones in front of the pavilion, which I will not describe further than by saying they are not gravel.

---

* G. M. Seabroke, Esq., has kindly taken two photographs of Newbold. They are on a small scale.

† An admirable Panoramic Sketch, in water colour, of the curved strata in the Newbold Lime Works, has since been made and presented by Mr. W. C. Marshall.

‡ Considerable progress has since been made in this work, but much remains to be done.

§ They have since been found by J. M. Lester.

Fourthly, comparison may be made between the lias here and elsewhere in England, both as respects its mineral structure and its fossils. By doing this we may ultimately be able to form some well grounded judgment on the circumstances under which the lias was deposited.

This leads me, Fifthly, to suggest papers on the geological history of this locality; in which judgment and skill and wide knowledge are required, but which it is well worth occasionally to attempt. Beware, however, of over great confidence in any theories you may form : aim at what Bacon calls the "*adulta suspensio judicii.*"

Sixthly, you may do excellent work in accurately describing Fossils. Let us have papers or notes ere long on such subjects as the varieties of form of the *Gryphæa incurva*; the extraordinary power of the *Ostrea* to make its shell fit the surface to which it is attached; the varieties of form of *ammonites* in different stages of growth; description of *ammonite* and *nautilus*; description of rare fossils. One of our members (E. Cleminshaw) had the good fortune to discover one of the rarest fossils in Britain—the *Discina Holdeni* (or *Orbicula),* and that in such abundance that he has been able to present some specimens to the Museum, and to send through me some more to Mr. Davidson (the author of the *Monograph on Brachiopoda,* in the Palæontographical Society's Works), who very liberally sent us 25 named species in return, from his private collection.

I must now conclude my suggestions as to the subjects for the Geological Section to work at. You may easily find more, but I have mentioned those which seem to me at present to be of the greatest importance. In order to make our study effective, I think we should establish a joint Geological Note Book or Album, into which notes and papers, which have been read to the Society, should at once be transferred by their authors, and from which, perhaps, at the year's end a selection may be made by the Editing Committee for publication in our yearly volume. Such a Note Book as this will outlive all our own private books, and will in time become valuable, both for the information which will be accumulated in it, and as a record of the scientific activity of our time.

Afterwards a Paper was read by E. CLEMINSHAW "On the Structure of the *Belemnite.*"

In all 33 persons were present.

MEETING HELD MAY 18TH, 1867.

Lemna (Wolffia) arrhiza, lately discovered in England at Staines, with short notes, exhibited by F. R. SMITH.

Bones and teeth of bison, deer, horse, &c., and ancient flint weapons from the river Gravel, at Newton, Newbold, and Lawford, by E. CLEMINSHAW.

Bones of *Ichthyosaurus tenuirostris* from Newbold, by E. CLEMINSHAW and P. MAHONY.

Shieldrake's egg from Barry Island; Curlew and Bearded Tit, Glamorganshire; by A. C. BRUCE.

Ermine's skin from Wiltshire, by J. S. MASTERMAN.

Orchis morio, from Rugby, by Mr. F. E. KITCHENER. In this flower a fly had pushed its head against the stigmatic surface, and was still there, having been unable to overcome the force of the viscous fluid.

R. ETHERIDGE, ESQ., F.G.S., of the Geological Survey, then addressed the Society at some length on the bones found in the river Gravel by E. CLEMINSHAW.

In all 23 persons were present.

MEETING HELD JUNE 1ST, 1867.

The Exhibitions were—

Lima gigantea, from New Bilton, by A. C. BRUCE.

Avena pratensis, var. *pubescens*, by Mr. F. E. KITCHENER.

A branch of variegated oak, returning to its primitive leaves, which were entirely green, by Mr. J. M. WILSON.

Ophioglossum lusitanicum, and *Gymnogramma leptophylla*, from Guernsey, by REV. T. N. HUTCHINSON.

Beak of Toucan, by W. C. MARSHALL.

Stone exhibiting glacial action, from Hungerfield, by P. MAHONY.

Liassic Coral, from Hillmorton, by the same.

Ammonites armatus, and *A. Guibalianus*; Ripple marks on the New Red Sandstone, from Hungerfield; and Plates of a Crustacean, from Hillmorton; by E. CLEMINSHAW.

A Question from the Question Book—"What meaning can be attached to the letters 'A.H.' on a piece of lead found when the tree was moved in the close?"—asked by P. Mahony, was answered by the President:—

In the reign of Charles II., owing to the want of small change (no copper coinage being as yet in English circulation), about 8,000 tradesmen issued coins, of intrinsic value far inferior to that for which they passed current. This practice was forbidden by laws of every sovereign from Elizabeth to Charles II., and was only put down by the issue of a good copper coinage in the reign of the latter Monarch. Among these tradesmen there were five men of Rugby, viz.:—

Luke Barrow, Feltmaker, 1667.
William Boyes, Mercer, 1669.
William Chebsey, Mercer.
Abraham Harper, Mercer.
Millecent Tilghman.

Of the above Abraham Harper a half-penny is in the collection of M. H. Bloxam, Esq.: Obverse—Mercer's Arms; Legend, "Abraham Harper." Reverse—"A+H." in a circle, surrounded by "Mercer in Rugby."

It is clear, then, that the A.H. on the otherwise unmarked leaden token (the property of P. Mahony, of this Society) refer to Mr. Abraham Harper. This is confirmed by the similarity of the letters, and by the pellet between the letters. We must suppose this not to be a coin, but a token issued for some purposes of trade.

Several similar leaden tokens were found at the same time (Nov., 1865). One other was only recorded (in the possession of H. D. Acland, of the School-House) on which the letters were W.S. To these initials no meaning can be at present attached.

In considering how these tokens came where they were' found, we must remember that the present School-close was then part of the fields attached to the Manor House of Rugby. The Schools were then on the site of the present Almshouses by the Old Church, and it was not till 1748, under the Headmastership of Dr. Krail, that the site of the new Schools was bought. Where the School-house now stands had stood the Manor House of Rugby, part of which was probably built in the time of Charles I.

Of Mr. Abraham Harper, the School Register shows that he, in common with others of the five tradesmen mentioned above, availed themselves of the Foundation. In the Headmastership of Robert Ashbridge—1674-1681—we find the following entry:—

"1680.—Thomas Harper, son of Mr. Abraham Harper; Foundationer."

And about the same time we find the names of Chebsey, Tilghman, and Boyes.

In the Parish Register we have the last notice of the coiner—

"1 March, 1692.—Buryed Mr. Abraham Harper."

Note.—Since the above notes were read, the following letter has been received from M. H. Bloxam, Esq.:—"Abraham Harper was Churchwarden of Rugby in 1661 and in 1663. He is described as 'Gent,' and paid Hearth-money for three. As to the leaden tokens, I think they are earlier than 1648; probably of the reign of Elizabeth, or early part of the reign of James I. Leaden tokens were a species of tokens of which very little is known; they are supposed to be the 'Plumbios Angliæ' mentioned by Erasmus. Copper farthings were issued in 1613 by James I., and also by Charles I., but these were quite insufficient, hence the issue between 1648 and 1672 of Tradesmen's Tokens in copper and brass, of which between 9,000 and 10,000 specimens are known to exist. In 1672, on the issue from the Mint of legalised currency in copper farthings, and half-pence, the circulation of tradesmen's tokens was forbidden."

In all 23 Persons were present.

MEETING HELD JUNE 15TH, 1867.

THE following were exhibited:—

Leucojum Æstivum (new plant to our district), by E. P. KNUBLEY.

Rugby Orchids in spirits, by P. MAHONY.

Cypripedium calceolus, gathered wild in Yorkshire a few days before this exhibition; and Monstrosity of Tulip, showing internodes between floral leaves, by Mr. F. E. KITCHENER.

Roman Pottery from Blisworth, by E. CLEMINSHAW.

Isoetes hystrix from Guernsey, by Rev. T. N. HUTCHINSON.

Casts of *Pleurotomaria*, and *Lingula Beanii*, from Newbold; *Rotella lobelliformis*, and *Goniomya rhombifera*, from Hillmorton; and Rugby Fresh-water Shells; by E. CLEMINSHAW.

A Paper was read by A. C. BRUCE "On the accurate Division of the Local Lias at Rugby into Zones, by their Fossils, more especially by their *Ammonites*."

By means of their Fossils we can distinguish between the numerous subdivisions of one large Geological system, such as the Lias, the different beds of which might be thought contemporaneous if they were not found superposed on one another in an unalterable order (of which the oldest of course lies at the bottom); and accordingly the different fossils of the various beds of any stratum, and here of the local Lias, ought to be known well. Take, for instance, the Newbold or New Bilton Pits. The first thing noticed is the regular order of the different strata, each overlying the other like the pages of a book. These strata were originally formed at the bottom of a deep sea, where the sediment was strewed by the current and then stratified; that is, the layers were heaped one upon another in a regular order, each layer being newer than the one below it. In this soft mud there were then deposited sea-shells, bones of sea-reptiles, and the corals of that period; or, if at the estuary of a river, land plants and remains of land animals, &c.

Mud and sediment were brought down by floods and deposited at the bottom of the sea. Next the rivers dissolved carbonate of lime from different rocks, which they carried along to their estuaries, and which, settling with the other sediment, formed the alternate layers of shale and limestone. These strata were spread over a vast area. The Lias, for instance originally extended from the Isle of Skye, over North Ireland, to Lyme Regis (Dorset) and to the Jura mountains. And all this huge tract of land was then one great sea, which we call "The Liassic Sea," and into which rivers were carrying down sediment and carbonate of lime, among which fossils were gradually getting embedded. Now we have only a *small* remnant of this vast formation, in the shape of a long line of Lias which runs through England from Whitby to Lyme Regis,

MEETING HELD JUNE 29TH, 1867.

THE following objects were exhibited:—

Trigonia clavellata, presented to the Arnold Library by Mr. C. S. TAYLOR (O.R).

Fossils, including the jaw of *Icthyosaurus communis* from New Bilton Limeworks, by E. CLEMINSHAW.

Genista pilosa, and *Saxifraga oppositifolia* from Helvellyn, by W. C. MARSHALL.

Nest and Eggs of Golden-crested Wren, &c., by F. C. SELOUS.

G. B. LONGSTAFF exhibited various Galls, and read notes thereon.

A Paper was read "On Sea Anemones," by the REV. T. N. HUTCHINSON, who exhibited several specimens from his own aquarium, among which was a family of young ones not 24 hours old.

In all 24 persons were present.

MEETING HELD JULY 13TH, 1867.

The Exhibitions were—

Weaver-Bird's Nest, by J. M. LESTER.

Slough of the Common Viper, by E. P. KNUBLEY.

Snout of the Sword-fish, and Saw of the Saw-fish, with short descriptions, by F. R. SMITH.

Lima alternans (new to the district); *Ammonites planorbis*, characteristic of lowest bed of the Lias, at Newnham; Fish-scales from Newbold; and various Fossils, by E. CLEMINSHAW.

Two species of *Emmelesia* and other Moths new to Rugby, by G. B. LONGSTAFF.

Lemna minor in flower, and *L. gibba* (refound), by H. C. READER.

An Address was made "On Geological Research in England and India," by DR. OLDHAM, Superintendent of the Geological Survey of India.

A vote of thanks was passed to Dr. OLDHAM, for the gift of "Palæontologica Indica" and "Memoirs of the Geological Survey of India."

In all 26 persons present.

MEETING HELD OCTOBER 26TH, 1867.

Aquilegia alpina, from Switzerland, with spurs of the Nectaries eaten by Insects, by the President.

Fossil Fish remains from Newbold, the first complete fish found, scales only having been found hitherto,—by J. LAWE.

Red and Grey Chalks with Fucoids, from Hunstanton, by the President.

An Address was made "On Cromer Forest," illustrated by lignite and remains of the mammoth collected there, by the President.

In all 16 persons were present.

MEETING HELD NOVEMBER 9TH, 1867.

The following Exhibitions were made:—

A Fossil found here, by E. CLEMINSHAW, and which, being identified with one found in Ireland, has since been named *Discina Holdeni.*

Erebia Cassiope and *Cœnonympha Davus* from the English Lakes, lately taken, and presented by W. C. MARSHALL.

A Paper was ready "On Protective Resemblances among Insects," by MR. A. SIDGWICK. The Paper was illustrated by specimens from the writer's collection. We extract the following:—

If we consider what are the means of defence which animals possess in that struggle for existence which is going on around us, none will so readily occur to us as that of concealment; and of course it is of the greatest possible use to them in concealing themselves, to resemble in colouring and form the substances among which they live. If, for instance, a moth lives among tree trunks, it will obviously be of the greatest possible advantage to it to resemble the lichens, mosses, and general colouring of the trunk. And according to the principle of Natural Selection, those who by any accidental variation (in the first instance) chanced to have such a protective resemblance, would have most likelihood of escaping the birds, bats, and other numerous enemies of their race; and thus the colouring would be inherited by the next generation, and would gradually tend to become the prevailing characteristic of the species.

We shall have no lack of instances to illustrate this theory, even if we confine ourselves to the Insect world only. Among the moths, for example, we are struck at once with the fact that an enormous proportion of them are coloured so as to resemble the trees, the walls, the lichens, the palings on which they sleep during the day-time. Of the larger species, the brighter colours, if there are any, are most often found on the under-wings, which are completely concealed when they are at rest, while the upper-wings are dusty or grey, and readily escape notice. Thus, besides the genera of Yellow Under-wings and Red Under-wings in which this peculiarity is most marked, there are a very large number whose under-wings are white, quite bright enough to increase considerably their chance of death if they were exposed to view. Even in the case of the brightly marked tiger-moths, the upper-wings are far more quiet in their appearance, while for the under-wings is reserved that superfluity of gaudiness which renders them such striking objects in a collection. The hawk-moths, which are on the whole certainly brighter than the nocturnal, are found to be the strongest and most rapid fliers, and therefore have less need of the protection of concealment.

If we turn now to the Butterflies we shall find that in spite of their undeniable brilliancy, they also are not devoid of imitative colours and other protective means of concealment. For it must be remembered that the time when they are most defenceless is not when they are flying, but when they are at rest. And while the larger moths always rest with their upper-wings exposed and their under-wings (so often brighter in colour) generally concealed, the butterflies on the other hand rest always with their wings erect, thus concealing the gaudy upper colours and only displaying the dull under-side. For example, the splendidly coloured Peacock is almost black when at rest, and on a twig would be unnoticeable. The same is true of the Tortoise-shell. The whole tribe of lovely little Blues are spotted grey beneath, a colour far less easy to distinguish. And it is singular that the only British butterfly* which is coloured green (the hue which would be a real protection) is so coloured on the *under*-side.

So far, then, we have found *general* resemblances in the colouring of insects to the prevailing colours of the substances on which they rest. And we have not exhausted the instances. Thus it has been remarked that the majority of autumn moths have autumn colourings, the various shades of yellow and brown being far more numerous among them than among the summer specimens. Again, the winter moths have a general grey or silvery appearance, to suit the season of the year. Almost all chrysalises are deep brown, the colour of the earth. An enormous proportion of caterpillars are green, the colour of leaves; while among those that are not so, the whole tribe of Geometræ bear a resemblance to pieces of stick so pronounced and striking that it requires a thoroughly practised eye to detect them.

---

* Thecla rubi, "the Green Hair-streak.'

But if these general resemblances are close enough to make us wonder, we shall wonder still more at the degree to which imitation is carried by individual insects. Thus the Buff-tip moth, when at rest, looks exactly like a piece of grey twig, while the light yellow of the tail and tips of the wing (which all lie closely packed together) resembles the broken end of the wood inside the bark. There is a very gaudy Indian butterfly whose under-side, in infinite variety of marking, always resembles a decaying leaf. The caterpillar of the Emperor moth, which feeds on the heather, has a ground colour of green to match the leaves, and a sprinkling of red spots to match the buds. There is a small beetle, called *Ontophilus*, which is just like a seed; and another, a *Curculio*, just like the loam pits in which it lives. The Lappet moth, in shape as well as colour, is almost undistinguishable from a dry leaf; while I myself have more than once mistaken *Cilix Compressa*, a little white and grey moth, for a piece of bird's dung dropped upon a leaf, and *vice versa* the dung for the moth. *Bryophila Glandifera* and *Perla* are the very image of the mortar walls on which they rest; and only this summer, in Switzerland I amused myself for some time in watching a moth, probably *Larentia tripunctaria*, fluttering about quite close to me, and then alighting on a wall of the stone of the district, which it so exactly matched as to be quite invisible a couple of yards off. A writer in the *Westminster Review** mentions a butterfly observed by himself in Sumatra, which, on the very few occasions when it could be seen at rest, was found with its wings closely shut and brown in colour; its tail attached to the twig as a stalk; the body lifted away from the twig by means of two slender and invisible legs; and altogether so exactly resembling one of the dead leaves among which it was sitting, that, though he saw *scores* of them about, he never, except once or twice, could catch one at rest. They appeared to pitch upon the dry trees and vanish out of sight.

But there remains one more class of illustrations which I should like to mention before concluding, and which, to my mind, is the most interesting of all. Thus far we have considered insects which escape observation by resembling in colour, &c., inanimate objects for which they may be mistaken. But there are instances in which they undeniably bear a close resemblance to other insects, of quite different orders or families, and entirely separate from them in structure; and where it is a highly probable conjecture that this similarity serves them as a protection. The insects which they imitate are preserved by other modes of protection apart from colour; and the imitators are preserved by their likeness to them.

Thus everyone has been struck with the singular family of Hawk moths, called Clear-wings. There are fifteen species in Great Britain alone, all more or less closely resembling bees, wasps, ichmeumons, gnats, and other stinging insects. There can be no reasonable doubt that to most or all of these this similarity constitutes a powerful protection. Not only does man mistake them for stinging insects, but also no doubt birds, &c., that would gladly gobble them up if they knew they were only wretched moths, refrain for fear of the sting. But let me draw again upon the *Westminster Review* for the most extraordinary instance of all, in this subject.

---

* July, 1867. "On Mimicry and other Protective Resemblances among Animals." It was this article that first supplied the motive, and many of the illustrations, of this paper.

There is in South America a family of butterflies conspicuous, white, slow-flying, termed *Heliconidæ*; and whereas their means of escape from their pursuers are very inadequate, they are furnished with a protection the most powerful of all; and that is, they are supremely nasty to the taste. In short the birds will not eat them. Young birds no doubt try, and suffer for it; and we may suppose that as soon as ever they can distinguish a *Heliconia*, they will leave him alone. So that in spite of their conspicuousness and slowness of movement, they enjoy a comparative immunity. But this is not all. There is another butterfly frequenting the same habitats, no relation whatever to *Heliconia*, but of quite different structure. This is called *Leptalis*, and would prove an excellent dinner for a bird, if only he could catch him. Why then can the bird not catch him? Because in form and colour the *Leptalis* so closely and accurately imitates the *Heliconia* as to be undistinguishable therefrom. We may imagine the bird sitting on the bough, waiting for his breakfast. Down come one, two, three, twenty, thirty *Heliconias*. Bird sits still. "I have tried that lot once," says the bird; "you won't catch me running after those stinking white fellows again; not if I know it." Presently down comes a *Leptalis* (for they are much rarer than the *Heliconia*). Bird sits still. "Only another of the same sort," thinks he. And so the tender *Leptalis* escapes, and all from his borrowed plumage.

These are only a selection from the instances which meet the inquirer, illustrating this interesting subject, from every side. I have necessarily confined myself to the insects, though there are as conclusive and almost as striking examples to be found among the higher animals.

It only remains then just to cast a glance back over our facts, and ask ourselves again, what do we gather from them. There can be very little doubt that a large proportion of these protective resemblances have been perpetuated, promoted, and to a great degree produced by the process, combined through a long course of ages, of natural selection; or in other words, many of these resemblances which are now found universally in any particular species, have been originally accidental; out of a variety of colours produced by the fertility of nature, those which are most protective, have preserved the individuals which possess them; while the more conspicuous have perished. In the next generation there have been a larger number endowed with the imitative colouring, and in the next, according to the law of inheritance, a still larger; and so on till at last the imitative colouring has become common to the whole species.

But at present, there are too few facts observed and recorded, to justify us in stating our conclusion more decisively. It is a subject as unexplored as it is interesting; and it is to the future accumulation of facts and observations that we must look for the extension and confirmation of this striking theory.

In all 29 persons were present.

MEETING HELD NOVEMBER 23RD, 1867.

Fossil Fish Remains from the chalk, Palatal Teeth, portions of Vertebræ, &c., by J. LAWE.

So called "Fossil Fruit," from Hillmorton,* by O. LEGGATT.

A curious form of Asplenium *(Ruta Muraria?)* from Cornwall, by J. M. LESTER.

A Paper was then read "On the Floral Types into which Great Britain has been divided," by W. C. MARSHALL.

Plants may be classified either by their structure or distribution. It is my object to explain the system of estimating the Distribution of Plants adopted by Mr. Watson in his *Cybele Britannica*, and also in the *London Catalogue of British Plants*. The whole of Great Britain has been divided by Mr. Watson into 18 provinces, most of which form the basins of considerable rivers. Then, by comparing local Floras, and seeing in which of these provinces each flower occurs, we have a rough estimate of the distribution of plants, and their comparative rarity. This system was followed in the older editions of the *London Catalogue*, and the numbers put after each plant indicated in how many of these provinces each was found. The large size of the divisions, however, rendered the results obtained by this system unsatisfactory; for it is evident that of two plants occurring only in one province, one plant might be distributed all over it, while the other was only to be found in a particular spot. For instance, here at Rugby we are in the Severn province, and the Pæony and other flowers peculiar to the mouth of the Severn would be put down in our Flora, just as much as the common flowers we meet in every field. For these reasons Mr. Watson has since subdivided Great Britain into 112 districts: thus the Severn province is now divided into eight districts. This gives us a more accurate census; and the only obstacle to still more accurate results is the want of local Floras such as that compiled by our President. The system of 112 districts is now adopted in the *London Catalogue*, the number of districts in which each plant is found being put after it; when any plant occurs in more than 25 districts, the numbers go in leaps of 10, as being more easy to remember. I should like here to mention that a new grade between a species and a variety has been introduced in the *London Catalogue*, and marked by a short line placed before them. This seems a concession to Darwin, who maintains that species are only big varieties. By means of these divisions relations can be traced between plants and the soil, climate, and latitude of the districts in which they grow. But there is another consideration to be taken into account, namely, the altitude above the sea at which they are found; for, as you ascend any of the higher mountains, you will observe many species disappear one by one as it gets too cold for them, and others more hardy appear; and though in different localities the same species will be found rising to very different heights, yet, as a rule, a species that rises higher than another on one chain of mountains will also be found higher on another. The difference between the flowers on the mountains and in the neighbouring valleys often gives rise to the isolation of a few species. The mountain variety of Sea Thrift is an instance of this. The *only inland* localities for this are the tops of high mountains; and it is a curious question how these few plants got so far separated from the rest. They may have been the relic of an age when England was so far submerged that these mountain tops were really close to the sea; or perhaps when the climate was colder it extended over the intermediate valleys, and then as the weather became milder again some went up the hills, the rest to the cool sea shore. Watson has divided our British plants into the following Climatic Zones:—

---

* These remains were afterwards analysed by G. B. Longstaff, and found to be Coprolites.

Infer Agrarian Zone, in which alone *Clematis* is found.
Mid Agrarian Zone, in which *Rhamnus Cartharticus* is found, without *Clematis.*
Super Agrarian Zone, in which *Pteris Aquilina* is found, without *Rhamnus.*
Infer Arctic Zone, in which *Erica Tetralix* is found, without *Pteris.*
Mid Arctic Zone, in which *Calluna vulgaris* is found, without *Erica.*
Super Arctic Zone, in which *Salix Herbacea* is found, without *Calluna.*

Our Rugby plants have not yet been divided according to the climatic zones to which they extend, but they would probably range from Mid Agrarian to Mid Arctic. It is hoped some member will make this calculation. Our district would be partly *Infer Agrarian*, and partly *Mid Agrarian.*

From the distribution of plants in the provinces and climatic zones, a third method has been deduced by Mr. Watson, who classes all our British plants under one of the following types of distribution:—

(1.) British Type.—In this group are included those plants which are found pretty equally distributed in all or nearly all the provinces. To this type, also, all alien plants are referred. Examples: *Potenilla Tormentilla, Myosotis arvensis;* of Aliens, *Mimulus.*

(2.) English Type, including all plants which are adapted to the climate of England, especially the southern counties. Examples: *Rhamnus Catharticus, Lamium Galeobdolon.*

(3.) Highland Type, including the flowers which are limited to the mountains or their immediate vicinity. Examples: *Alchemilla alpina, Azalia procumbens.*

(4.) Scotch Type.—This is the opposite of the English Type, and contains those flowers which are confined to Scotland and the northern counties of England. Examples: *Primula farinosa, Geranium sylvaticum.*

(5.) Germanic Type.—There are several flowers which are characterised by a tendency towards the south-eastern counties, such as the Chalk Plants. Examples: *Silene noctiflora, Bupleurum tenuissimum, Anemone Pulsatilla.*

(6.) Atlantic Type.—Contains those plants which have a tendency towards the western coast, and is therefore the opposite of the Germanic Type. Examples: *Pinguicula lusitanica, Erica vagans.*

(7.) Besides these there is a **LOCAL OR DOUBTFUL TYPE**, which contains those plants which show no decided inclination towards the north, south, east, or west, and yet are not generally enough distributed to be classed in the British Types. Examples: *Draba muralis*, *Hutchinsia petræa*.

Here at Rugby we have 557 out of the 1428 species native to Britain. Of these, 405 belong to the British Type, 130 to the English, 6 to the Scotch, 7 to the German, and 7 to the Local. The specimens of the Scotch and German types are mostly plants introduced by cultivation; so that, in reality, we have none but the British and English Types.

The following is the per-centage of flowers found at Rugby belonging to each type:—British 72 per cent., English 23, Scotch 1⅛, Germanic 1¼, Local 1¼.

Mr. Watson has spent much labour in collecting the facts and classifying the flowers in the three manners I have mentioned, but he has not himself put forward any theory to account for the way in which plants are distributed, and rather implies, in his *Cybele Britannica*, that the facts as yet collected are not sufficient to form the basis of any theory. Forbes has, however, endeavoured to account for the distribution of our British plants, by natural migration from the neighbouring countries, when, during some remote geological epochs, they were connected or nearly connected with England; and though I am afraid any one who has been in the Geological Set will have heard his views far better explained, yet I think it would be a pity to leave the subject without mentioning them. Forbes has divided England into the following Floras:—

(1.) **ASTURIAN FLORA**, which is confined to the south-west of Ireland. There are 12 species characteristic of this Flora, and native of no country nearer than Portugal.

(2.) **NORMAN FLORA**, corresponding to Watson's Atlantic Type, and also spreading over the south of Ireland. This Flora closely resembles that of Brittany.

(3.) **KENTISH FLORA**, corresponding to Watson's Germanic Type, the flowers of which are allied to those of France.

(4.) **SCANDINAVIAN FLORA**, corresponding to Watson's Highland and Scotch Types.

(5.) **GERMANIC FLORA**, occupying the greater part of England and Ireland, and the south of Scotland. This includes Watson's British and English Types.

According to Forbes the Asturian is the oldest of these Floras. Its isolation and southern character are, he thinks, evidence of extreme antiquity, and possibly point to Ireland and Portugal having been joined. There hardly seems evidence enough in the 12 plants to justify this theory. The distribution of the second and third Flora took place when France and England were joined, as is proved beyond all doubt by Geology. Forbes supposes the fourth, or Scandinavian Flora, to have come over during the second glacial period, when England was at a much lower level than at present, and the mountain tops formed a chain of low islands, surrounded by a glacial sea, and stretching up towards Norway. In this case it is probable that the transportation of plants was chiefly effected by floating ice. The distribution of the Germanic Flora depended upon the upheaval of the German Ocean, and the connection of Ireland with England, and England with Germany, by wide and flat plains.

[Note.—The Plants recorded at the time the above paper was read were 557 in number, out of the 1428 species of the *London Catalogue* (6th Edition).

Of the nine Germanic Plants, *Campanula hybrida* and *Silene noctiflora* are corn-field weeds; *Chenopodium urbicum* and *Leucojum æstivum* are not far from gardens; *Myosurus minimus*, *Inula pulicaria*, and *Carduus acaulis*, though credibly recorded, are not to be found now; and *Iberis amara* and *Linum perenne* are recorded, with no reliable authority given. We have, therefore, really less than one per cent., and those introduced as weeds.

Of the six Scottish, two—*Trollius Europæus* and *Equisetum hyemale*—are mistaken entries. Of the others, *Campanula latifolia* is still at Coton—1866, H. C. L. R.; *Salix pentandra* is recorded in Purton's *Midland Flora; Salix nigricans* and *Vicia Sylvatica* by Mr. Bloxam; and *Pinus sylvestris* is, of course, not indigenous to England. None of these are necessarily natives, and, apart from the casualties of introduction, the Rugby Flora is three parts British to one English, and nothing else. It will be well to keep an eye on the temporary or permanent incursions of aliens.—F. E. K.]

A specimen of Larva from New Zealand *(Hepialus virescens)*, with a long Fungus *(Spœria Robertsii)* growing out of its head, was exhibited by F. C. Bayard, and led to discussion, G. B. Longstaff mentioning the growth of a Fungus on the British *Hepialus lupulinus.*

21 in all were present.

MEETING HELD NOVEMBER 29th, 1867.

This Meeting was specially called to receive the Collection of Butterflies and Sphinges presented by Rev. J. Hayward (o.r.)

Mr. Hayward addressed the Society on the way in which he became a Naturalist, in the days when N.S. was unknown; he made a strong appeal to egg-collectors not wantonly to destroy the eggs of the rarer birds, and enlarged on the great usefulness of a Naturalists' Note Book.

32 persons were present.

MEETING HELD DECEMBER 7TH, 1867.

Butterflies and Moths to illustrato Mr. Sidgwick's paper on Mimicry, by J. M. LESTER.

Collection of about 400 Plants, made in Switzerland and Germany, during the Summer holidays, 1867, by F. R. SMITH.

A List of about 70 Birds observed near Rugby within the last three or four years, was then presented by H. C. READER.

A Paper was then read "On Protective Resemblances," in continuation of Mr. Sidgwick's subject, by J. M. LESTER. The following are some of the instances of protective colouring quoted:—

To come back to British Fauna: rabbits are a very good example of this mimicry of nature, particularly of the soil and vegetation among which they live. This remark applies especially to yellow ones, which I have occasionally seen wild in the fir-woods of Scotland. On the shores of Loch Fine, owing to the sandy soil in which they lived, they were undiscernable at any distance; and even when you approached them, unless they were moving, it was very hard to see them. This sort, however, is not at present very plentiful, not more than two in 100 being yellow; but I am told that during the last 10 years they have increased, and must continue doing so as long as they frequent this same soil. For the same reason another variety, the black sort, which is at the present time more plentiful than the yellow, ought to decrease rather, offering such a good mark as it does both to men and beasts.

BIRDS.

Now to turn to birds. The Wood-dove, when perched amongst the branches of its favourite *fir*, is scarcely discernable; whereas, were it among some lighter foliage, the blue and purple tints in its plumage would far sooner betray it. The Robin Redbreast too, although it might be thought that the red on its breast made it much easier to be seen, is in reality not at all dangerous to it, since it generally contrives to get among some russet or yellow fading leaves, where the red matches very well with the autumn tints, and the brown of the rest of its body, with the bare branches.

So many others of our English birds, such as the Tree-creeper, the spotted Woodpecker, and Fly-catcher, are peculiarly well adapted to their mode of life, crawling and flitting about among the trunks and branches of trees, so as to be seen with difficulty, from their resemblance to the holes and spots on the bark.

A Paper was then read by E. CLEMINSHAW, "On the

Natural History of the Rugby Lias," illustrated by his large Collection of Local Fossils.

Collecting Fossils is undoubtedly the chief incitement to the study of Geology; but I want you to regard a fossil as more than a stone, for it once had life, and there is a History attached to it. I think, then, that it may not be uninteresting if I give a slight sketch of the Geology of this district, and try and describe, as well as I can, the different fossils we meet with, and explain the nature and habits of the animals they belonged to.

Let me first say a few words upon the Geology of the Lias. The Lias, Oolite and Cretaceous series, extend in a general direction [from] N.E. to S.W. across England, and all these formations slope gradually to the S.E. Therefore, a bed or stratum which lies to the N.W. was deposited before the bed which lies more to the S.E.—the Lias before the Oolite, and the Oolite before the Green-sand and Chalk. The oldest stratum which we meet with in this neighbourhood lies to the N.W., and is exposed in some quarries at Newnham Regis. Then over that was deposited the Newbold and New Bilton Limestone, then the New Bilton Clay, the Clay at the clay-pits on the Dunchurch road, the Clay at Hillmorton and Lower Hillmorton, and lastly, the Clay at Kilsby. I continue the series to Kilsby, because that is the top of the Lower Lias: the Marl-stone, or Middle Lias, capping the hills close to it. The Lower Lias, then, extends from Newnham Regis to Kilsby.

I will commence with the lowest bed near Newnham Regis. There are some Limestone quarries near that place, where we find bands of hard Limestone, partly blue and partly white, and discoloured by iron. Just above this Limestone there is a bed of brown shale of some thickness, and in this shale we meet with some small Ammonites, and a few small shells. There is also a good deal of crystallised sulphate of lime in the shale, called Selenite.

Let me now try and explain the nature of the Ammonite when alive. The Ammonite shell is found to bear a striking analogy to the Nautilus, which is living in the seas at the present time; we can therefore discover the nature of the Ammonite by studying the Nautilus. The Ammonite consists of a shell, coiled up in the shape of a disc, and these coils are divided at intervals into chambers, by certain partitions. The exterior of a cast of an Ammonite frequently shows marks resembling flutings, or deeply-fringed foliage,—they are the edges of these partitions. Sometimes we find nothing but the interior cast of the chambers, which fit exactly into one another. The chambers are pierced by a tube called a siphuncle, which runs through the whole of the chambers; it is frequently seen well preserved in Ammonites, and is always seen in the Nautilus shell. According to its analogy with the Nautilus, the siphuncle is connected with the animal, and it can fill it with some liquid which it has the power of secreting. The siphuncle has no connection with the interior of the chambers, and this liquid would make the shell heavier in proportion to its bulk, and so it would sink; upon the withdrawal of the liquid the shell would become specifically lighter, and would ascend. The empty chambers serve to give the shell buoyancy. We find the same provision in several other shells.

Both the Nautilus and Ammonite occupied the outer chamber only, and when that was too small it made a new partition, and so made a new chamber. The animal itself very much resembled the cuttle-fish, or *sepia*, in appearance, having the same long arms. The shells appear to have been covered with beautiful iridescent colours, which are occasionally preserved; and as the Ammonites ranged from the size of a pin's head to a cart-wheel, some of them must have been very beautiful objects, as they swam along the surface.

The first Ammonite, then, that we find here, is in the brown shale I have just mentioned, at Newnham Regis, and it is called *Ammonites Planorbis*, from its likeness to the common river shell *Planorbis*. It is generally small, and not striking in appearance, having scarcely any markings on it at all. Perhaps this is owing to the fact that this is almost the first Ammonite that lived, for as we ascend through the Lias and Oolite up to the Chalk, we find that the Ammonites get more and more ornamented. This small Ammonite is an important one, for it marks the limit of the Lower Lias proper. All along the Lias we find this Ammonite marking the lowest bed of the Lias; while below occurs a mass of limestone, shale, and sandstone, which are classed as the Rhœtic series, and are regarded by some geologists as "passage beds," and by others as forming part of the Trias, or New Red Sandstone. The top limestone beds are generally called the "White Lias," which we have here at these Newnham Regis quarries. In the shales not much else is found but the Ammonites, and many spines of a small Cidaris *(C. Tomesii)*, an animal very much like the Sea Urchin or *Echinus* of our own seas. In the White Lias we do not find much either. There are many small bivalve shells found in great masses, but not in very good preservation. We find, however, the characteristic *Avicula decussata* and the *Ostrea Liassica*, and species of Myacites. The rock seems charged in some places with minute Cidaris spines, and valves of the *Cyprina*—a very small crustacean, enclosed in two valves, and something like small animals which inhabit our ponds. There are also large slabs of limestone, which seem to be covered with casts of Fucoids, or sea-weeds, but it is impossible to be certain about them. The White Lias is the only part of the Rhœtic Series which we have exposed here, and it is about the most uninteresting. Lower down in the series, bones and teeth of Saurians and fish remains are very plentiful.

Geologists have found it convenient to divide the Lower Lias into certain "Zones," or bands, each of them characterised by certain Ammonites,—the lowest by *A. Planorbis*, the next by *A. Bucklandi*, the next by *A. angulatus*. But this must not be taken too literally, as some are inclined to do; it may be true that these Ammonites are confined to a certain band, in one place, but that they have survived longer in another place, and this seems to be the case here. We find that the *A. angulatus* reached its fullest development in the very zone in which we find the *A. Bucklandi*, and thus the "zones" are somewhat confused.

Little is found at the few points where the rock is exposed between Lawford and Newbold, except I might mention the *Lima alternans*, which is the only specimen of this species of Lima yet discovered in this neighbourhood: I have lately, however, found what seems to be a part of a large *Ammonites angulatus*, also *Lima Gigantea*, *Gryphea incurva*, and some species of Cardium and Myosites. When we come to the newer stratum of Newbold, we find that a change has come over the animal life: the fossils are much larger and more numerous. We find the large fine shell *Lima gigantea* or *Plagiostoma giganteum*, which has reached its full developement. The strata here consist of layers of limestone and shale, and I might mention that they have been somewhat broken and contorted. They are almost on the same level as the Lime-works at New Bilton. We here find, not unfrequently, the remains of some of the most extraordinary of all the fossil animals that are met with. I allude to the Saurians, the Icthyosaurus and Plesiosaurus.

The Saurians first appear in the Trias or New Red Sandstone; but do not seem to have reached their full development until we come to the Lias. The Icthyosaurus was the most plentiful here, for only 3 vertebræ of the Plesiosaurus have been discovered as yet. The animal must have been of great size: the average length is 6 to 8 feet, and many are discovered which must have measured 20 to 30 feet in length. The Icthyosaurus (Fish-Lizard) had a large head, pointed like that of a porpoise, and armed with a great number of conical teeth, like a crocodile's, of true Reptilian form; its vertebræ and short neck bear a great resemblance to the fishes, and its long tail and paddles again resemble the porpoise. There was a peculiarity in the eye which ought to be mentioned: it was supported by a number of pieces of bone, such as are seen in the eyes of birds of prey, and these enabled the Saurian to alter the distance of distinct vision, for seeing at a distance and close to. Its breastbone was composed of a number of pieces of bone, which were laced together and formed an intricate piece of net-work, which gave it greater strength, as is the case in the crocodile. Thus we see what a number of different forms are combined in the structure of a Saurian. The Plesiosaurus (nearer a lizard) differed from the Icthyosaurus in having a smaller, flatter head, and immensely long neck, and smaller body and tail, and the vertebræ were much longer than those in the Plesiosaurus. It has been compared to a serpent strung through the body of a tortoise. Both these animals lived in the shallows and in estuaries and fed upon the fishes they found there. We, therefore, find the fish-scales at Newbold and New Bilton associated with the Saurian remains. Numbers of beautifully delicate shells may be found in some of the shale beds associated with the fish-remains—the *Avicula* being very common. The new species of the Discina—*D. Holdeni*—which I discovered some time ago, was a small bivalve shell, shaped very much like a Limpet, and which grows on larger shells: the shell I discovered it on is a large specimen of *Ammonites angulatus*. I would advise everyone to examine well an Ammonite or a Lima, for there may be some of these small shells on it. Another shell which we meet with now is very common here and in the Lias generally. I allude to the *Gryphea incurva*, resembling a hooked oyster shell. At Newbold we meet with, for the first time, the stems of the Pentacrinus. This Pentacrinus was a zoophyte furnished with a long flexible jointed stem, with which it fixed on to a rock: at the top was the body of the animal containing the mouth and viscera, and it was provided with a great quantity of flexible jointed arms. At Rugby, we seldom find anything but the pieces of the stems and arms, although whole ones have been discovered here. A good specimen is to be seen in the Natural Science School. There is a band of limestone, which occurs at Newbold and New Bilton, which yields great numbers of a shell called *Rhynconella*,—a small shell somewhat like a cockle. It seems to have been very plentiful at that time, but rarely discovered elsewhere in this neighbourhood. Ostreas are also found at Newbold in some quantity, and there is a small Lingula—*Lingula Beanii*, which is not common. Fucoids (sea-weeds) and pieces of Lignite (fossil wood) are found now and then. The Ammonites are *A. Bucklandi*, *A. angulatus*, A. *Semicostatus*. If we pass on to New Bilton Limeworks, we find much the same level of strata, but it is not nearly so productive. The shale, however, is very full of fossils, mostly consisting of Aviculæ, fucoids, impressions of Ammonites, and Fish Scales. I found also, some time ago, a rare Avicula—*A. Papyria.** Passing to a higher level, we come to the Clay Pits, at New Bilton, where we find a somewhat different character of fossils. Saurians are not nearly so plentiful. I think only a few vertebræ of the Icthyosaurus have been discovered as yet. The *Lima Gigantea*, so common at Newbold, is already becoming scarce, and the Ammonites have somewhat changed. We find the *Ammonites angulatus* in plenty, but smaller than it is at Newbold. *A. Semicostatus* is very common also. In the bands of limestone, through the clay, we meet with small shells, as *Pectens*, *Lima pectinoides*, *Avicula Sine-muriensis*, etc. We find also the Nautilus — *Nautilus striatus*—for the first time at these Clay Pits. The *Gryphea incurva* is very abundant, but it seems to have reached a fuller development than when the Newbold beds were deposited; Ostreas are also very plentiful. Pentacrinus stems are also frequently met with, sometimes on Lignite, which is generally charged with Iron Pyrites. Indeed, most of the fossils in this bed are charged with that substance more or less. As we pass up into the higher bed of clay, which is exposed at the Clay Pits on the Dunchurch Road, we find a somewhat different class of fossils. The large *Lima Gigantea* seems to have almost disappeared, for only one specimen has as yet been discovered. No Saurian remains have been found. And we find a new Ammonite coming in—*A. Man augenisti*; but we still find the *A. Bucklandi.* The limestone concretions are generally full of small fossils, chiefly *modiolæ*, *cardiniæ*, etc. Some remains of a species of crab has just been discovered in it. On the whole this bed is not very productive. The next bed is exposed at some Clay Pits near Upper Hillmorton, and it is the most productive and the most interesting. Just at this time, or it may be just at this place, animal life seems to have been very abundant in the Liassic Sea. Ammonites are found in great quantities, ranging from the smallest to some of a large size. They have also become much more diversified in their markings. Another important fossil, which we first meet with at Hillmorton, and which is very abundant, is the *Belemnite*, about which I will say a few words. From very perfect specimens it is found that the *Belemnite* shell belonged to a creature which had a great resemblance to the Cuttle Fish or Squid, which is common on some of our coasts. All these animals were furnished with long fleshy arms or feelers round their heads, and with an ink bag, from which they could eject some dark thick substance, which would darken the water and enable them to escape from their enemies. The Cuttle Fish was provided with a tough horny substance, which gave strength to the body, and acted as a guard and protection to the animal, since it swam backwards. In the *Belemnosepia* (as the fossil animal is called) the conical *Belemnite* shell acts as the guard. This is what we generally find preserved. The guard was prolonged into a kind of sheath, which held the ink bag and the other viscera. It also held a series of air-chambers, called the *Phragmacone* resembling a pile of watch-glasses, and which was pierced all through with a Siphuncle, as in the case of the Ammonite, and which probably served the same purpose. Sometimes we find the Phragmacone preserved, and I have discovered a very fine specimen at Hillmorton; the ink bag is also frequently found in a very perfect state at Lyme Regis, in Dorsetshire. Now there is a great resemblance between the structure of the Ammonite and that of the Belemnite. The arms and head are the same in both animals; the Ammonite has the air chambers outside, living inside the shell. The *Belemnosepia* has the air chambers inside, and as it had no outward protection it was provided with a guard and an ink bag. These animals were extremely plentiful, and seemed to have swarmed in the old Liassic Seas. I discovered, a little while ago, some scales of a Crustacean, probably of a crab. We still find the *Gryphea incurva* the Nautilus, and the Pentacrinus stems; the Rhynconella, however, is very rare, and no specimen of the *Lima Gigantea* has as yet been discovered. Some white nodules are frequently found, and G. B. Longstaff has analyzed them; they are found to contain some phosphate of lime, and are, therefore, probably, nodules formed round the excrement of Saurians. Mr. Wilson predicted that we should soon find the bones also of the Saurians.* The Calcareous Nodules are generally full of fossils. Many new shells have now come in, among which I might mention *Pholadomya ambigua*, *Pleurotomaria Anglica*, *Modiola scalpum*, *Arca*, *Unicardium cardioides*, *Goniomya rhombifera*, *Hippopodium ponderosum*, etc., etc.

---

* NOTE.—The Avicula in the shale has been determined to be A. Papyria.

The Ammonites most common in this bed are A. *armatus*, A. *armatus-densinodus*, A. *Birchii*, A. *Semicostatus*, A. *Planocostatus*, A. *Guibalianus*. The *Ostrea* and *Plicatula spinosa* and the *Serpula* are also frequently met with on shells of larger size. We still find *Lima pectinoides*, and many species of Pectens. On the whole the Upper Hillmorton bed is singularly productive and interesting.

The stratum just below this, which is exposed at some pits in the village of Lower Hillmorton, is on the contrary, very poor in fossils.†

The next place where we find the Lias exposed is at some rubbish heaps close to the Kilsby Tunnel, which have been made at the excavation of the Tunnel. Not very much is to be found, but the calcareous nodules are generally rich with specimens of *Modiola*, *Arca*, *Pecten*, etc. The Ammonites I have found there are A. *planocostatus* and A. *cornucopia*. A few Belemnites are to be found, and a little while ago I found some very good chambers or part of the Phragmocone of *Belemnites elongatus*, also species of *Pentacrinus*, *Pleurotomaria*, *Pinna*. This bed at Kilsby is the highest stratum of the Lower Lias, and is followed by the Marlstone or Middle Lias.

We have now reviewed the whole of the Lower Lias of this neighbourhood: first we find the hard limestone of the White Lias—then the shale beds, which constitute the base of the Lower Lias proper—then hard blue limestone, poor in fossils—then layers of argillaceous limestone and shale, which gradually change into beds of clay, with occasional bands of limestone and calcareous nodules.

---

* In confirmation of this prediction, a vertebra of an Icthyosaurus has boeen discovered at Hillmorton during the Holidays, by J. M. Lester.

† A new pit in the village has just been opened, and several fossils have been found in the stratum, including Gryphea incurva, Belemnites elongatus, Pentacrinus stems, Ammonites armatus, A. Guibalianus, Cardinia ovalis, Pholadomya, Pinna, and coprolitic nodules.

The ancient Liassic Sea must have been a large basin in which muddy sediment was being deposited; and some parts of this basin must have been estuaries, as, for instance, at Lyme Regis, in Dorsetshire. Huge Saurians infested the shallows, feeding with the fishes which they met with there; Cuttle fishes swarmed in the water, and crinoids and fucoids were in great plenty. The muddy character of the Lower Lias was unfavourable for the growth of corals, and one small coral, the *Montivaltia*, is to be found, of which, I think, only a few specimens have been discovered at Newbold; I have since, however, found a specimen of it at Upper Hillmorton. Occasionally there must have taken place sudden accessions of muddy sediment, which overwhelmed the Saurians and their excrements, without allowing them time to decompose, for sometimes Saurians are found in a very perfect state, scarcely a bone out of place. If we turn to the evidences of terrestrial life, which we have in the Lias, we find they are very few in this neighbourhood. Wood pyritised and in the form of Lignite is plentiful, and a few reeds are discovered now and then; but this is all discovered at present. From researches elsewhere we find that many plants and insects were in existence. Parts of the Lias in Gloucestershire were evidently under the action of rivers, for there are several bands in the Lower Lias there, which are charged with the remains of several genera of coleoptera and the wing cases of beetles; plants are also found there, mostly ferns, cycads, and leaves of monocotyledons.

In conclusion, let me caution you from supposing that what has been hitherto discovered represents the whole animal life of the period when the Lias was deposited. We have only a small part of it. Many animals no doubt perished, and were not preserved; and it must be remembered that the places where the rock and clay are exposed are very few, and many fossils no doubt remain to be discovered.

Year by year fresh discoveries are made. It is only lately that Saurian remains began to be plentiful at Newbold, and Fish remains were found last year for the first time. There is still much to be done and much to be discovered: this can only be accomplished by diligent search.

The President congratulated E. Cleminshaw on the Paper which he had read, and the Society generally on the very successful Meetings of the past Term.

The Society was then adjourned till the next year.

In all 24 persons were present.

Number of Meetings held in 1867, 12.

Average attendance in	Spring	Term	28.5.
,, ,,	Summer	,,	22.8.
,, ,,	Autumn	,,	24.4.

ENTOMOLOGICAL NOTICES.

VERY little can be known of the Rugby insects until we have more observers. This branch of Natural History, although one of the most interesting, has been most neglected. In spite of this several interesting additions have been made during the year. We may mention the following Lepidoptera:—

Tæniocampa Gothica. A specimen bred from a pupa found near Brownsover.
Cidaria suffumata. Taken on a fir trunk in April in Frankton Wood.
Stigmonota perlepidana. Flying on railway banks. May.
Micropteryx calthella. Abundant near Frankton. May.
Hemerosia rhediella. Flying. Frankton, and Trent Valley Railway Bank. May.
Hedya servilana. A specimen at Coombe. June.
Lobesia reliquana. Same place and time.
Emmelesia decolorata. Amongst Lychnis vespertina. June.
Anticlea rubidata. Amongst Galium mollugo, near Birdingbury station.
Scotosia vetulata. Amongst Rhamnus; abundant near Birdingbury station, and a specimen near Hillmorton. June.

Amongst the few Coleoptera collected in early Spring, the following deserve mention:—

Lathrobium longulum. Near Brownsover.
Lathrobium elongatum. Same place.
Philonthus bipustulatus, and _Myrmidonia limbata_. In ants' nests in the sand pits at Hillmorton.
Othius fulvipennis. In one of Mr. Boughton Leigh's spinnies.
Conurus pubescens. Coombe.
Achenium depressum. Brownsover.

A School Collection of Insects is going to be formed, and a Committee has been appointed to arrange it. The Collection at present consists of a large Case given by Mr. WILSON, which contains a number of Lepidoptera taken by a man named EDMUNDS; of a small collection of various orders, by Mr. WRATISLAW (O.R.), of Bury St. Edmunds; a collection of Butterflies and Sphinges, presented by Mr. HAYWARD (O.R.); and a box of Insects sent by Mr. WRATISLAW. A complete list of the species in this Collection is in preparation.

LIST OF THE LEPIDOPTERA

(Butterflies and Moths) which have been Observed within Eight Miles of Rugby.

(The arrangement according to Doubleday.)

Those with no initials in brackets observed by G. B. Longstaff in 1866–1867.
" " A. S. " " A. Sidgwick, Esq.
" " A. H. W. " " Rev. A. H. Wratislaw.

DIURNI.

Pieridæ.
Pieris brassicæ
" rapæ
" napi
Anthocharis cardamines
Rhodoceridæ.
Gonepteryx rhamni
Colias Edusa (A.S.)
Vanessidæ.
Argynnis Paphia
" Adippe
" Euphrosyne
" Selene
Vanessa C-album (A.H.W.)
" urticæ
" polychloros (A.H.W.)
" Io (A.S.)
" Atalanta
Satyridæ.
Satyrus Egeria
" Megæra
" Janira
" Tithonus
" Hyperanthus
Chortobius Pamphilus
Lycænidæ
Thecla quercus
Polyommatus Phlœas
Lycæna Alexis
" argiolus (A.H.W.)
Hesperidæ.
Syrichthus alveolus
Thanaos Tages
Hesperia sylvanus
" linea (A.H.W.)

NOCTURNI.

Sphingidæ.
Smerinthus ocellatus (A.S.)
" populi
" tiliæ (A.S.)
Acherontia Atropos (A.S.)
Sphinx ligustri (A.S.)
Chærocampa Elpenor (A.S.)
Macroglossa stellatarum
" fuciformis
Sesidæ.
Sesia tipuliformis
Zeuzeridæ.
Cossus ligniperda (A.H.W.)
Hepialidæ.
Hepialus humuli (A.S.)
" sylvinus (A.S.)
" lupulinus
" hectus (A.S.)
Procridæ.
Procris statices
Zygænidæ.
Zygæna filipendulæ
" lonicera (A.H.W.)
Lithosidæ.
Nudaria mundana (A.S.)
Lithosia complanula (A.S.)
Chelonidæ.
Chelonia Caia
Arctia lubricipeda
" menthastri
Liparidæ.
Liparis auriflua
" salicis
Orgyia pudibunda (A.S.)
" antiqua

Bombycidæ.
Trichiura cratægi (A.S.)
Bombyx quercus
Odonestis potatoria
Lasiocampa quercifolia (A.S.)

GEOMETRÆ.

Urapterygidæ.
Ourapteryx sambucata
Ennomidæ.
Rumia cratægata
Metrocampa margaritata
Pericallia syringaria
Selenia illustraria (A.S.)
Odontopera bidentata (A.S.)
Amphidasydæ.
Phigalia pilosaria (A.S.)
Nyssia hispidaria (A.S.)
Biston hirtaria (A.S.)
Amphidasys betularia
Boarmidæ.
Boarmia repandata
" rhomboidaria
" abietaria
Geometridæ.
Iodis lactearia
Ephyridæ.
Ephyra punctaria
Acidalidæ.
Asthena luteata
" candidata
" sylvata
Acidalia scutulata
" bisetata
" incanaria
" remutata
" aversata
" emarginata
Timandra amataria
Caberidæ.
Cabera pusaria
" exanthemaria
Macaridæ.
Macaria liturata
Halia Wavaria
Fidonidæ.
Strenia clathrata
Fidonia piniaria
Zerenidæ.
Abraxas grossulariata
Lomaspilis marginata
Hybernidæ.
Hybernia rupicapraria
" defoliaria
Larentidæ.
Cheimatobia brumata
Oporabia dilutata
Larentia didymata
" pectinitaria
Emmelesia alchemillata
" albulata
" decolorata
Eupithecia castigata
" lariciata
" vulgata
" exiguata
Ypsipetes elutata
Melanthia ocellata
Melanippe tristata (A.S.)
" biriviata
" montanata
" fluctuata
Anticlea rubidata
Coremia ferrugata
Camptogramma bilineata
Scotosia dubitata
" vetulata
" certata
Cidaria corylata
" russata
" suffumata
" fulvata
" pyraliata
Eubolidæ.
Eubolia mensuraria
Anaitis plagiata
Chesias spartiata (J. S. Masterman)

DREPANULIDÆ.

Platypteryx falcula

PSEUDO-BOMBYCES.

Dicranuridæ.
Dicranura furcula (A.S.)
" vinula

Pygæridæ
Pygæra bucephala
Notodontidæ.
Notodonta camelina (A.S.)
" dictæa (A.S.)
Diloba cæruleocephala

NOCTUÆ.

Noctuo-Bombycidæ.
Thyatira derasa (A.S.)
Bryophilidæ.
Bryophila perla (A.S.)
Bombycoidæ.
Acronycta tridens (A.S,)
" psi (A.S.)
" megacephala (A.S.)
" alni (A.S.)
" rumicis (A.S.)

Apamaidæ.
Gortyna flavago (A.S.)
Axylia putris (A.S.)
Xylophasia lithoxylea (A.S.)
" polyodon
Mamestra brassicæ
Apamea basilinea
" oculea
Miana strigilis
" arcuosa
Caradrinidæ.
Grammesia trilinea (A.S.)
Noctuidæ.
Agrotis exclamationis
Tryphæna pronuba
Orthosidæ.
Teniocampa gothica
" instabilis (A.S.)
" stabilis (A.S.)
Anchocelis pistacina
Hadenidæ.
Polia chi (A.S.)
" flavicincta (A.S.)
Phlogophora meticulosa
Euplexia lucipara (A.S.)
Xylinidæ.
Cucullia umbratica (A.S.)
Heliothidæ.
Heliodes arbuti
Phalænoidæ.
Brephos notha (A.H.W.)

Plusiidæ.
Plusia iota
" gamma
Gonopteridæ.
Gonoptera libatrix
Euclidiidæ.
Euclidia glyphica

DELTOIDÆ.

Hypenidæ.
Hypena proboscidalis
Herminiidæ.
Herminia tarsipennalis

AVENTIIDÆ.

Aventia flexula

PYRALIDES.

Ennychiidæ.
Pyrausta purpuralis
Herbula cæspitalis
Hydrocampidæ.
Cataclysta lemnalis
Paraponyx stratiotalis
Hydrocampa nymphæalis
" stagnalis
Botydæ.
Botys urticalis
Ebulea sambucalis
Pionea forficalis
Scopula lutealis
" olivalis
" prunalis

PLICATÆ.

Scopariidæ.
Scoparia ambigualis

CRAMBI.

Crambidæ.
Crambus pratellus
" pascuellus
" perlellus
" culmellus
" hortuellus

TORTRICES.

Cymbidæ.
Halias prasinana

Tortricidæ.
Tortrix rosana
" ribeana
" viridana
Peronea variegana
Dictyopteryx Lœflingiana
" Bergmanniana
Penthinidæ.
Penthina pruniana
" cynosbana
Spilonotidæ.
Pardia tripunctana
Sericoridæ.
Sericoris lacunana
" urticana
Sciaphilidæ.
Cnephasia musculana
Sciaphila subjectana
" hybridana
Grapholithidæ.
Phoxopteryx diminutana
Grapholitha campoliliana
Phlæodes tetraquetrana
Coccyx strobilana
" Hyrcyniana
Endopisa nebritana
Stigmonota perlepidana
Pyrodes Rheediana
Catoptria ulicetana
Pyraloididæ.
Xylopoda Fabriciana
Conchylidæ.
Lobesia reliquana
" servillana
Xanthosetia hamana
Tortricodes hyemana

TINEÆ.

Tineidæ.
Incurvaria Oehlmanniella
Micropteryx calthella
" seppella
" allionella
Nemophora Swammerdammella
Adela Degeerella
" viridella
Hyponomeutidæ.
Swammerdammia pyrella
Gelechiidæ.
Depressaria applanella
Phibalocera quercella
Œcophoridæ.
~~Œcophora unitella~~
" pseudospretella
Endrosis fenestrella
Glyphipterygidæ.
Glyphipteryx Fischeriella
Argyresthiidæ.
Argyresthia nitidella
Gracilariidæ.
Gracilaria Swederella
Ornix Anglicella
Coleophoridæ.
Coleophora nigricella
Elachistidæ.
Chrysoclysta flavicapitella
Elachista rufocinerella
" cygnipennella
Tischeria emyella
Lithocolletidæ.
Lithocolletis Cramerella

PTEROPHORINA.

Pterophorus trigonodactylus
" pentadactylus

ALUCITINA.

Alucita polodactyla

BOTANICAL NOTICES.

NEARLY all our known plants have been "called over" during the past year. A date has been kept of the first time each flower was found in blossom, but it will be seen that a flower may often have been out some days before it was found, the more so when the number of observers was limited. It is hoped that many others, whether members of the Society or not, will help us next year. The Marlborough Natural History Society have already kept a calendar of plants for three years, and could we do the same, in a systematic manner, an interesting comparison might be made between the dates of flowering of Warwickshire and Wiltshire. We borrow from the experience of that Society some hints for the guidance of our own observers.

(1.) State carefully whether the flower is only just out, or may have been out some time. If the latter, say—"by February 23rd."

(2.) State where the plant grew as clearly as you can, in order that, if possible, the same plant may be observed in future years.

(3.) Some well-known cultivated plants may fairly be observed; particularly, say, well-known trees, easily identified. Of trees, give three dates—when in leaf, when in flower, when leafless.

(4.) Any peculiarities in the weather likely to retard or advance the flowering, should be noted.

(5.) A list of plants in flower on October 1st, November 1st, and December 1st.

(6.) A list of plants is desired which grow on the New Red Sandstone, say as far from Rugby as the Chapel Wood, King's Newnham, and in that direction.—See Geological Map. (Class A.)

(7.) Also of plants which grow on railway banks, canal banks, or in disused pits, and may, therefore, possibly, have been imported. (Class B.)

(8.) Also of plants which grow on the alluvial soil on the banks of the river. (Class C.)

(9.) In order to enable us to judge what plants are peculiar to each of these classes, it would be well to notify what plants are found elsewhere.

For convenience, it may be well to divide the country generally into—

Class D., Bilton and Wolston District, lying between the Lawford and Dunchurch roads;

Class E., Barby, between Dunchurch and Upper Hillmorton roads;

Class F., Hillmorton, between Upper Hillmorton and Clifton Roads;

Class G., Coton and Lilbourne, between the Clifton and Coton Roads;

Class H., Newbold, from Dunchurch to Coton roads.

The following plants, new to the district, have been added this year (the numbers refer to Bentham, 1865); several escaped plants, having been found for some years, are here first rcorded.

XX. 1. *Geranium Striatum*, naturalised in a spinney near Rugby Mill; P. Mahony.

XXIV. 8. *Trifolium hybridum*, occurs frequently, naturalised, near Rugby; H. C. Reader.

XXV. 11. *Poterium* 1. *Sanguisorba (muricatum)*, Birmingham railway bank; B.; Rev. A. Bloxam.

XXVII. 2. *Peplis* 1. (*Portula*), Frankton Wood; H. C. Reader.

XXXII. 12. *Carum* 2. *Carui*, (B.) footpath to Lawford, and railway bank at Brandon; by H. C. Reader.

XL. 11. *Anthemis* 2. *Arvensis* (H.), field near Newbold; H. C. Reader.

27. *Centaurea Scabiosa* (G.), near Newton; H. C. Reader.

LIV. *Lycium barbatum* (Tea plant), Bilton; F. E. Kitchener.

LV. 7. *Nepeta* 2. *Cataria* (G.), Catthorpe; H. C. Reader.

11. *Marrubium* 1. *Vulgare* (D.), field on Lawford road.

LXVI. 1. *Euphorbia Cyparissias*, near Blue Boar; E. P. Knubley; H. C. Reader.

LXXVII. 5. *Potamogeton* 2. *heterophyllus*; pond in Frankton Wood; H. C. Reader.

LXXXII. 2. *Galanthus* 1. *nivalis*, escaped near Bilton; H. C. Reader.

3. *Leucojum* 1. *æstivum*, escaped near Little Lawford Hall; E. P. Knubley.

LXXXIV. *Lilium Martagon*, escaped in spinney near Rugby Mill; H. C. Reader.

Ruscus Aculeatus, escaped near Bilton; E. P. Knubley.

LXXXV. 1. *Juncus compressus* (B.), near Rugby coal wharf; H. C. Reader.

9. *Carex* 12. *paniculata*, Hungerfield; F. E. Kitchener.

9. *Carex* 43 *pseudo cyperus*, pond near Frankton wood; H. C. Reader.

LXXXVI. 2. *Milium* 1. *effusum*, Hungerfield; H. C. Reader.

36. *Catabrosa* 1. *aquatica*, pond near Bilton; F. E. Kitchener.

LXXXIX. 1. *Equisetum* 1. *Telmateia* (B.); pit near Lawford Road; Rev. A. Bloxam, and F. E. Kitchener.

XC. 7. *Aspidium aculeatum* (*angulare*); recovered; Rev. T. N. Hutchinson.

REGISTER OF PLANTS FOR 1867.

In this List it must be remembered that the School was away from Rugby between April 23rd and May 9th, and during the months of August and September.

The following dates have been recorded by F. E. Kitchener, H. C. Reader, F. R. Smith, and E. P. Knubley, and others.

Forms of Notices can be obtained from the President, to whom they should be sent, or to H. C. Reader.

Thalictrum	
Flavum	**June 20th**
Anemone	
Nemerosa	**April 18th**
Ranunculus	
Aquatilis	**May 18th**
Hederaceus	**by June 15th**
Flammula	**June 17th**
Ficaria	**Feb. 21st**
Scaleratus	**May 20th**
Acris	**May 11th**
Bulbosus	**May 15th**
Arvensis	**May 24th**
Caltha	
Palustris	**April 5th**
Berberis	
Vulgaris	**May 23rd**
Nuphar	
Lutea	**June 20th**
Papaver	
Rhœas	**June 12th**
Dubium	**June 17th**
Fumaria	
Officinalis	**May 15th**
Barbarea	
Vulgaris	**May 13th**
Nasturtium	
Officinale	**May 1st**
Palustre	**July 26th**
Amphibium	**July 1st**
Arabis	
Thaliana	**April 10th**
Cardamine	
Amara	**May 23rd**
Pratensis	**April 18th**
Hirsuta	**Mar. 25th**
Sisymbrium	
Officinale	**May 18th**

Alliaria	
Officinalis	April 22nd
Brassica	
Campestris	May 15th
Sinapistrum	May 27th
Alyssum	
Calycinum	May 20th
Draba	
Verna	Feb. 12th
Teesdalia	
Nudicaulis	April 24th
Capsella	
Bursa-pastoris	by Feb. 16th
Lepidium	
Campestre	by June 30th
Senebiera	
Coronopus	July 10th
Viola	
Odorata	Feb. 23rd
Hirta	April 10th
Canina	April 18th
Tricolor, var. *b.*	May 15th
Polygala	
Vulgaris	May 15th
Lychnis	
Vespertina	May 18th
Diurna	by June 3rd
Githago	June 29th
Flos-cuculi	May 24th
Sagina	
Procumbens	May 27th
Arenaria	
Serpyllifolia	May 24th
Trinervis	April 24th
Cerastium	
Vulgatum, var. *a. b.*	Feb. 10th
Stellaria	
Media	Jan. 28th
Uliginosa	May 23rd
Graminea	June 3rd
Holostea	April 27th
Spergula	
Arvensis	June 13th
Montia	
Fontana	April 9th
Hypericum	
Perforatum	July 26th
Quadrangulum	June 6th
Pulchrum	July 6th
Linum	
Catharticum	by July 27th
Malva	
Rotundifolia	by July 14th
Sylvestris	June 29th
Tilia	
Intermedia (L.C.)	June 3rd
Geranium	
Phæum	May 20th
Pratense	June 18th
Robertianum	May 11th
Lucidum	May 15th
Molle	May 15th
Dissectum	June 1st
Erodium	
Cicutarium	June 8th
Oxalis	
Acetosella	April 9th
Acer	
Campestre	May 15th
Pseudo-platanus	April 18th
Ulex	
Europæus	Jan. 28th
Sarothamnus	
Scoparius	June 1st
Lupulina	May 1st
Melilotus	
Officinalis	July 27th
Trifolium	
Pratense	May 15th
Repens	June 1st
Procumbens, L.C.	June 12th
Minus, L.C.	May 24th
Striatum	June 8th
Fragiferum	June 8th
Lotus	
Corniculatus	by June 15th
Ornithopus	
Perpusillus	June 29th
Vicia	
Hirsuta	May 20th
Cracca	May 15th
Sepium	by June 9th
Sativa	May 15th
Lathyrus	
Pratensis	June 20th

Prunus
Communis, var. spinosa April 9th
Cerasus .... April 18th
Spiræa
Ulmaria .... June 29th
Geum
Urbanum .... May 15th
Rubus
Idæus .... May 27th
Fruticosus .... June 6th
Fragaria
Vesca .... May 20th
Potentilla
Fragariastrum .... April 10th
Reptans ....by July 27th
Tormentilla .... May 15th
Anserina .... May 27th
Alchemilla
Vulgaris .... May 23rd
Arvensis .... April 9th
Sanguisorba
Officinalis ....by July 8th
Poterium
Sanguisorba .... June 6th
Agrimonia
Eupatoria ....by July 27th
Rosa
Canina .... May 27th
Arvensis .... June 15th
Pyrus
Malus .... May 11th
Cratægus
Oxyacantha .... May 11th
Epilobium
Hirsutum .... July 26th
Montanum .... June 12th
Lythrum
Salicaria .... July 26th
Sedum
Acre .... June 6th
Ribes
Grossularia .... April 10th
Rubrum .... April 18th
Nigrum .... June 8th
Saxifraga
Granulosa .... May 15th
Tridactylites .... May 20th

Sanicula
Europæa .... May 24th
Heliosciadium
Nodiflorum .... July 26th
Sison
Amomum .... July 27th
Ægopodium
Podagria .... June 1st
Œnanthe
Fistulosa .... July 1st
Æthusa
Cynapium .... June 12th
Silaus pratensis ...... July 10th
Pastinaca
Sativa .... July 27th
Heracleum
Sphondylium .... June 1st
Scandix
Pecten .... May 15th
Bunium
Flexuosum .... May 24th
Chœrophyllum
Temulum .... June 1st
Sylvestre .... May 11th
Anthriscus ....by June 8th
Caucalis
Anthriscus .... by Oct. 20th
Daucus
Carota .... July 27th
Conium
Maculatum .... June 20th
Carum
Carui .... June 8th
Hedera
Helix ....by Oct. 20th
Cornus
Sanguinea .... June 8th
Sambucus
Nigra .... May 29th
Lonicera
Periclymenum .... June 4th
Galium
Cruciata .... April 10th
Verum .... June 29th
Saxatile .... June 4th
Mollugo .... June 29th
Aparine .... May 27th

Asperula	
Odorata	May 23rd
Sherardia	
Arvensis	May 1st
Valeriana	
Dioica	May 23rd
Officinalis	July 4th
Valerianella	
Olitoria	May 23rd
Scabiosa	
Succisa	by Oct. 20th
Tussilago	
Farfara	Feb. 16th
Chrysanthemum	
Leucanthemum	June 6th
Segetum	June 12th
Inodorum	June 12th
Matricaria	
Camomilla	July 4th
Anthemis	
Cotula	June 29th
Achillea	
Millefolium	June 17th
Gnaphalium	
Germanicum	July 4th
Senecio	
Aquaticus	July 27th
Jacobæa	July 27th
Carduus	
Nutans	June 5th
Palustris	June 17th
Centaurea	
Nigra	July 1st
Cyanus	July 14th
Tragopogon	
Pratense	June 1st
Leontodon	
Hispidus	June 1st
Hypochæris	
Radicata	June 15th
Sonchus	
Arvensis	July 26th
Oleraceus	June 12th
Taraxicum	
Dens Leonis	Jan. 28th
Campanula	
Patula	July 30th

Primula	
Vulgaris, var. *a* (Primrose)	Mar. 6th
Vulgaris, var. *c* (Cowslip)	May 11th
Lysimachia	
Nemorum	May 29th
Anagallis	
Arvensis	June 29th
Ilex	
Aquifolium	May 23rd
Fraxinus	
Excelsior	April 8th
Ligustrum	
Vulgare	July 4th
Vinca	
Minor	April 10th
Menyanthes	
Trifoliata	June 8th
Convolvulus	
Arvensis	July 26th
Sepium	by Aug. 6th
Myosotis	
Palustris, var. cæspitosa	June 2nd
Arvensis	May 11th
Collina	April 24th
Versicolor	May 11th
Lycopsis	
Arvensis	June 1st
Solanum	
Dulcamara	May 29th
Linaria	
Vulgaris	July 4th
Scrophularia	
Nodosa	June 15th
Veronica	
Serpyllifolia	May 6th
Officinalis	June 8th
Anagallis	June 12th
Beccabunga	May 24th
Chamœdrys	May 11th
Hederæfolia	Jan. 28th
Agrestis,	Feb. 7th
" var. polita	April 18th
Buxbaumii	May 23rd
Arvensis	May 29th
Rhinanthus	
Crista-Galli	June 6th

Melampyrum	
Pratense	June 8th
Calamintha	
Clinopodium	July 26th
Nepeta	
Glechoma	April 9th
Prunella	
Vulgaris	July 8th
Scutellaria	
Galericulata	June 8th
Stachys	
Betonica	July 14th
Sylvatica	June 12th
Galeopsis	
Tetrahit	June 29th
Ballota	
Nigra	July 14th
Lamium	
Purpureum	Jan. 28th
Album	April 2nd
Maculatum	June 8th
Galeobdolon	May 15th
Ajuga	
Reptans	May 15th
Plantago	
Media	June 1st
Lanceolata	April 22nd
Schleranthus	
Annuus	June 17th
Chenopodium	
Album .... by	July 7th
Atriplex	
Patula, var. *a*	June 29th
Rumex	
Acetosa	May 11th
Acetosella	June 5th
Polygonum	
Aviculare	July 4th
Convolvulus	July 4th
Persicaria	July 4th
Daphne	
Laureola	April 4th
Euphorbia	
Helioscopia	June 9th
Mercurialis	
Perennis	April 10th
Callitriche	
Aquatica	May 27th
Urtica	
Urens	June 1st
Dioica	June 3rd
Ulmus	
Montana	Mar. 3rd
Campestris	Mar. 10th
Alnus	
Glutinosa	Mar. 14th
Corylus	
Avellana	Feb. 14th
Fagus	
Sylvatica	May 15th
Quercus	
Robur, *a*, **pedunculata**	May 11th
Salix	
Alba	April 10th
Viminalis	April 10th
Caprea (nearly out)	Feb. 14th
Populus	
Nigra	April 10th
Taxus	
Baccata	April 1st
Sparganium	
Ramosum	July 8th
Arum	
Maculatum	May 11th
Potamogeton	
Natans	June 10th
Crispus	May 24th
Sagittaria	
Sagittifolia	June 8th
Alisma	
Plantago	July 27th
Listera	
Ovata	May 24th
Neottia	
Nidus Avis	May 29th
Orchis	
Morio	May 11th
Mascula	May 24th
Maculata	June 1st
Latifolia	May 23rd
Habenaria	
Bifolia	June 17th
Tamus	
Communis	June 17th
Scilla	
Nutans (nearly)	Mar. 27th

Juncus	
Communis, conglomeratus	**June 17th**
Luzula	
Campestris	**April 10th**
Scirpus	
Sylvaticus	**July 14th**
Carex	
Vulpina	**May 24th**
Acuta	**May 23rd**
Præcox	**May 24th**
Sylvatica	**May 24th**
Paludosa, var. riparia	**May 23rd**
Anthoxanthum	
Odoratum	**May 11th**
Phleum	
Pratense	**June 15th**
Alopecurus	
Pratensis	**May 11th**
Geniculatus	**May 27th**
Aira	
Cæspitosa (nearly)	**June 3rd**
Avena	
Fatua	
Pratensis, var. pubescens	**June 1st**
Flavescens	**June 7th**
Arrhenatherum	
Avenaceum	**June 17th**
Holcus	
Lanatus	**June 15th**
Hordeum	
Murinum	**June 7th**
Lolium	
Perenne	**June 6th**
Bromus	
Asper	**June 15th**
Sterilis	**June 1st**
Arvensis, *b*	**June 1st**
Dactylis	
Glomerata	**June 1st**
Cynosurus	
Cristatus	**June 7th**
Briza	
Media	**June 6th**
Poa	
Annua	**by June 12th**
Trivialis	**June 12th**
Equisetum	
Arvense	**May 24th**
Palustre	**May 24th**
Limosum	**May 24th**
Polypodium	
Vulgare	**April 2nd**
Scolopendrium	
Vulgare	**April 10th**

Plants once recorded on reliable authority, but not now to be found :—

Myosurus minimus. **Found since 1860 near Brownsover Mill (*vidi siccum*, F.E.K.).**

***Arenaria tenuifolia*—Gravel Pit; Lower Hillmorton Road, 1837 Rev. A. Bloxam.**

***Radiola millegrana;* "About a mile S. of Rugby, on side of Barby Road, opposite Mr. Richardson's farm," 1831; Baxter, in *British Phænogamous Botany*.**

***Genista Anglica;* "Barby Road, opposite Mr. Rogers' farm," 1837; Baxter.**

***Peplis Portula*; "Hillmorton Street, opposite *Plough*," 1831; Baxter; not there now, 1867, F.E.K., but found at Frankton, 1867, H.C.L.R.**

***Hydrocotyle vulgaris;* (*vidi siccum*, F.E.K.) taken since 1850; no locality marked.**

***Solidago virgaurea;* "In a lane on the left-hand side leading from the avenue, near the *Blue Boar*, towards Long Lawford;" Rev. A. Bloxam; not found 1867, F.E.K.).**

***Lactuca virosa;* "Road between Dunchurch and Willoughby," A.B., and "Road between Dunchurch and Southam," W. W. Baynes.**

***Inula pulicaria;* near Hillmorton; Rev. A. Bloxam.**

***Cuscuta Epithymum;* Lower Hillmorton Road.**

***Vaccinium Myrtillus;* near Rugby, 1832; W. W. Baynes.**

***Verbena officinalis;* about Rugby; Baxter's *British Phænogamous Botany*.**

Carduus acaulis; **"Further side of Old Canal, near Brownsover Mill," H. T. Sale; *v. s.*, F.E.K.**

Utricularia vulgaris; **"Old Canal, near Mr. Walker's house;" Baxter, and also Rev. A. Bloxam.**

Zannichellia palustris; **"In a pond in a field at the end of the first lane on the right hand side of the Upper Hillmorton Road going from Rugby, near Cleaver's garden," 1831; Baxter.**

Carex pulicaris; **"In some marshy ground near Rugby," 1817; Purton's *Midland Flora.***

Digitalis purpurea; **"Plentiful near Rugby," Purton, 1817; very rare now, though still found, 1867, F.E.K.**

Aspidium Oreopteris; **Dunsmore Heath; Doody in *Ray's Synopsis Methodica*, 1724.**

Plants recently found, which have disappeared:—

Coriandrum sativum; **Hillmorton Ballast Pits, and Lawford Road (1866), gone from both localities, 1867; H.C.L.R.**

Echium vulgare; **Trent Valley railway bank, down side, about 150 yards past the Newbold Limekilns (1866), not there now, 1867; H.C.L.R.**

Erysimum cheiranthoides; **field on Lawford Road, about half a mile from Rugby on left-hand side to Lawford (1866), not there now, 1867; H.C.L.R.**

Thlaspi arvense; **field at back of the house of Mr. Furness (1866), the enclosure has been dug and the plant disappeared, 1867: H.C.L.R.**

Aliens of which early notices are recorded:—

Berberis vulgaris; **"Back of Bilton Grange, and banks of Avon, near Holbrook," Baxter, 1831; still there, 1867, F.E.K.**

Fragaria elatior; **Coton Woods; "Mr. Nelson, gardener, said he had got it for the gardens there, where it had grown beyond the memory of man,"—Baxter. Is it still there? It is also naturalised on the bank at the ballast pits, Lower Hillmorton Road, 1866 and 1867; H.C.L.R.**

Saponaria officinalis; **"Naturalised in a hedge at the corner of a field that was formerly a garden, quarter of a mile from Rugby on the road to Barby," July 10, 1831, Baxter.**

Antirrhinum majus; **"On an old wall at bottom of gardens of Lawford Hall," 1831, Baxter; extant, 1867, F.E.K.**

Linaria Cymbalaria; **"Bilton Hall," 1831, Baxter; extant 1867, F.E.K.**

CORRIGENDA, 1867–1868.

Plants, erroneously recorded, which may be removed from the List until more reliable evidence be found:—

Trollius Europœus.
Cardamine impatiens; **"Barby Road;" no name.**
Linum perenne.
Salvia verbenaca.
Galeopsis Ladanum.
Polygonatum (multiflorum).
Equisetum hyemale.

Plants to be enclosed in brackets, as only obtainable outside the four miles:—

Sanicula (Europœa).
Chærophyllum (anthriscus).

Plants which may be written in italics, as only escaped from gardens:—

Aquilegia *vulgaris.*
Rosa *pimpinellifolia.*

ORNITHOLOGICAL NOTICES.

The following list has been some years in preparation by H. C. L. Reader. All the birds in it have been observed by him in the neighbourhood of Rugby (1863–67). Notices of dates in 1867 have been contributed by J. S. Masterman, F. C. Selous, E. Field, W. Field, F. S. Gwatkin, N. Masterman, W. Stunt, F. Adam, J. M. Lester.

It is hoped that next year many more, whether belonging to the Society or not, will join in making this list complete. Forms can be obtained from the President, to whom, or to F. C. Selous, all notices should be given. In general the dates given below are those of earliest egg observed in 1867.

I. Raptores.

(1.) FALCONIDÆ.

Falco Tinnunculus—Kestrel; May 16; F.S.G.
„ *Œsalon* —Merlin; Princethorpe, May 27.
Accipiter Nisus—Sparrowhawk; May 27.

(2.) STRIGIDÆ.

Strix Flammea—Barn Owl.

II. Insessores.

(1.) LANIADÆ.

Lanius Collurio —Red-backed Shrike.

(2.) SYLVIADÆ.

Accentor modularis—Hedge Sparrow; April 15; J.M.L.
Erythræa Rubecula—Robin; May; N.M.
Phœnicura Ruticilla —Redstart.
Saxicola œnanthe (*Bechstein*)—Wheat-ear; F.C.S.
" *Rubetra* —Whinchat; May 26; N.M.
Salicaria Locustella—Grasshopper Warbler.
" *Phragmitis*—Sedge Warbler; May 27; W.S.
" *Arundinacea*—Reed Warbler; F.C.S.
Philomela Luscinia —Nightingale.
Curruca atricapilla—Blackcap; May 25; W.S.
" *cinerea* —Whitethroat; May 16; F.S.G.
" *sylviella*—Lesser Whitethroat; May 25; W.S.
Sylvia trochilus—Willow warbler or Wren; May 25; W.S.
" *Hippolais*—Chiff-chaff.
Regulus cristatus—Gold-crest.

Parus major—Oxeye Titmouse; June 1st; W.S.
“ *cœruleus*—Blue Tit; May 21; W.S.
“ *ater*—Cole tit.
“ *candatus*—Large-tailed Tit—April 18; F.C.S.
Motacilla Yarrellii—Pied Wagtail; May 25; W.S.
“ *flava*—Yellow Wagtail.
Anthus arboreus—Tree Pipit; May 18; F.A.
“ *pratensis*—Meadow Pipit; May 25; W.S.

(3.) TRINGILLADÆ.

Alauda arvensis—Skylark.
“ *arborea*—Woodlark.
Emberiza Miliaria—Bunting.
“ *Schœnichus*—Reed Bunting; May 16; W.S.
“ *Citrinella*—Yellow-hammer; May 15; F.S.G.
Fringilla Cœlebs—Chaffinch; May 15; F. S. G.
“ *montana*—Tree Sparrow; May 18; W.S.
“ *domestica*—House Sparrow; May 18; N.M.
Coccothraustus Chloris—Greenfinch; May 21; W.F.
“ *vulgaris*—Hawfinch (Welton; F.C.S.)
Carduelis elegans—Goldfinch.
Cannabina Linota—Linnet.
Pyrrhula vulgaris—Bullfinch; May 16; W.S.

(4.) MUSCICAPADÆ.

Muscicapa grisola—Spotted Flycatcher; June 8; N.M.

(5.) CERTHIADÆ.

Certhia familiaris—Tree Creeper.
Troglodytes europœus—Wren; May 18; W.S.
Sitta europœa—Nuthatch.

(6.) TURDIDÆ.

Turdus viscivorus—Missel Thrush; April 13; F.C.S.
“ *pilaris*—Fieldfare.
“ *musicus*—Song Thrush; March 28; E.F.
“ *Iliacus*—Redwing.
“ *Merula*—Blackbird; April 15; N.M.

(7.) CORVIDÆ.

Corvus Corone—Carrion Crow.
“ *Cornix*—Hooded Crow.
“ *Frugilegus*—Rook; March 28; F.C.S.; young hatched, April 17; J.M.L.
“ *Monedula*—Jackdaw (young, May 27).
Pica Melanoleuca—Magpie; April 11; W.S.
Garrulus glandarius—Jay; May 18; W.S.

(8.) STURNIDÆ.

Sturnus vulgaris—Starling; May 17; F.S.G.

(9.) HIRUNDINIDÆ.

Hirundo rustica—Swallow; appears April 15; J.M.L.; eggs, June 28; N.M.; migrating September 30, flying S.E.; J.M.L.

Hirundo urbica—Martin.
" *riparia*—Sand Martin; seen April 28: eggs May 27; N.M.
Cypselus apus—Swift.

(10.) HALCYONIDÆ.

Alcedo ispida—Kingfisher.

III. SCANSORES.

(1.) PICIDÆ.

Picus viridis—Green Woodpecker.
" *minor*—Lesser Spotted Woodpecker.
Junx torquilla—Wryneck.

(2.) CUCULIDÆ.

Cuculus canorus—Cuckoo; May 27.

IV. GYRATORES.

(1.) COLUMBIDÆ.

Columba palumbus—Ringdove; April 9; W.M.
" *Turtur*—Turtledove; June 23; W.S.
" *Œnas*—Stock Dove (young, May 21); W.S.

V. RASORES.

(1.) PHASIANIDÆ.

Phasianus Colchicus—Pheasant.

(2.) TETRAONIDÆ.

Perdrix cinerea—Partridge.

VI. GRALLATORES.

(1.) CHARADRIADÆ.

Vanellus cristatus—Lapwing; April 15; N.M.

(2.) ARDEADÆ.

Ardea cinerea—Heron.

(3.) SCOLOPACIDÆ.

Scolopax rusticola—Woodcock.
" " *Gallinago*—Snipe.
" " *Gallinula*—Jack Snipe.

(4.) RALLIDÆ.

Crex pratensis—Corncrake; Landrail.
Gallinula chloropus—Moorhen; May 13; F.S.G.
Fulica atra—Coot; June 1; J.S.M.

VII. NATATORES.

(1.) ANATIDÆ.

Anas Boschas—Wild Duck; Mallard.
" *Crecca*—Teal.
" *Penelope*—Widgeon.

(2.) LARIDÆ.

Sterna Hirundo—Common Tern.*
" *nigra*—Black Tern.†

---

* Two or three birds of these species were noticed flying over the lake at Coombe Abbey, August, 1867; H.C.L.R.

† On April 28, five Sea Gulls were seen and heard by J.M.L.

GEOLOGICAL NOTICES.

A LIST OF LOCAL LIAS FOSSILS.

In this List is placed every *named* Fossil, both from private collections and the Arnold Library, and the different places are marked with a line where each Fossil occurs. This List is still imperfect: there are a good many Fossils found here which are still unnamed, and which puzzle the best Palæontologists. Several Fossils are now being sent to be named at the Jermyn Street Museum of Practical Geology, which will add considerably to this List.

Whenever a Fossil is found in a locality not given in this List, it is requested that notice may be given to the Keeper of the Geological Album, E. Cleminshaw.

Name of Fossil.	Newnh'm Regis.		Near Holbrook Grange.	Newbold.	New Bilton Limestone.	New Bilton Clay.	Dunchurch Road Pits.	Upper Hillmorton Clay.	Lower Hillmorton Clay.	Kilsby Tunnel.
	Rhætic.	Lower Lias.								
I. *Plantæ.*										
Fucoids	—	..	—	—	—					
Reeds?	..	..	..	—						
II. *Zoophyta.*										
Montivaltia rugosa	..	..	..	—	..	..	..	—		
III. *Echinodermata.*										
Pentacrinus, specimen of	..	—	—	—	—	—	—	—	—	—
P. basaltiformis	..	..	..	..	..	..	—			
P. Briareus	..	..	..	..	—	..	..	—		
P. robustus	..	..	..	—						
Cidaris Tomesii	—	—								
IV. *Articulata.*										
Serpula	..	..	..	—	—	—	—	—		
V. *Crustacea.*										
Crustacean scales, &c.	..	..	..	—	—	—	—	—		
Cypris	—	—	—							
Estheria? specimen of	..	—								
VI. *Brachiopoda.*										
Discina Holdeni	..	..	..	—						
Lingula Beanii	..	..	..	—						
Lingula, specimen of	..	..	..	—	—					
Rhynconella variabilis	..	..	..	—						
Rhynconella, specimen of	..	..	—	—	—	..	..	—		
Terebratula numismalis	..	..	..	..	..	..	..	—		

Name of Fossil.	Newnh'm Regis.		Near Holbrook Grange.	Newbold.	New Bilton Limestone.	New Bilton Clay.	Dunchurch Road Pits.	Upper Hillmorton Clay.	Lower Hillmorton Clay.	Kilsby Tunnel.
	Rhœtic.	Lower Lias.								
VII. *Lamellibranchiata.*										
(Monomyaria.)										
Avicula decussata										
A. papyria	..	..	..							
A. sinemuriensis	..	..	..	..	..					
Avicula, specimen of	..	..	..	..	..	..	..			
Gryphea cymbium	..	..	..			..	..			
Gryphea incurva	..	..								
Lima alternans	..	..								
Lima gigantea	..	..								
Lima rigida?	..	..	..	..	..	..	..			
Lima, specimen of	..	..	..	..	..	..	..			
Lima pectinoides	..	..	..	..	..					
Ostrea		..								
Ostrea laniscula	..	..	..	..	..					
Ostrea Liassica										
Plicatula spinosa	..	..	..	..	..	..	..		..	
Plicatula intusstriata										
Pinna diluviana	..	..	..	..	..	..	..			
Pinna, specimen of	..	..	..	..	..	..	..	..	..	
Pecten æquivalvis	..	..	..	..	..	..				
Pecten, specimen of	..	..	..							
VIII. *Lamellibranchiata.*										
(Dimyaria.)										
Arca	..	..	..	..	..	..			..	
Cardinia ovalis	..	..	..	..	..	..				
Cardinia Listeri	..	..	..	..	..	..	..			
Cardium		..		..			..			
Hippopodium ponderosum	..	..	..	..	..	..	..			
Leda complanata	..	..	..	..	..	..	..			
Modiola cuneata	..	..	..	..	..	..	..		..	
Modiola Hillana	..	..	..	..	..	..				
Modiola scalprum	..	..	..	..	..	..	..		..	
Modiola minima	?	..		..	..					
Myacites		..								
Goniomya rhombifera	..	..	..	..	..	..	..			
Pholadomya Gibbosa	..	..	..	..	..	..	..			
Pholadomya ambigua	..	..	..	..	..	..	..			
Unicardium cardioides	..	..	..		..	..				
IX. *Encephala.*										
(Gasteropoda.)										
Actæonina fragilis	..	..	..	..	..	..				
Dentalium	..	..	..	..	..	..	..			
Pleurotomaria, specimen of	..	..	..						..	
Pleurotomaria Anglica	..	..	..	..	..		..			
Rotella lobelliformis	..	..	..	..	..	..	..			
Turritella	..	..		..		..				
Chemnitzia	..	..	..	..	..	..				
Scalaria Liassica?	..	..	..	..	..	..				

Name of Fossil.	Newnh'm Regis.		Near Holbrook Grange.	Newbold.	New Bilton Limestone.	New Bilton Clay.	Dunchurch Road Pits.	Upper Hillmorton Clay.	Lower Hillmorton Clay.	Kilsby Tunnel.
	Rhætic.	Lower Lias.								
X. *Encephala.*										
(Cephalopoda.)										
Ammonites armatus	..	..	..	..	..	—	..	—	—	
A. armatus densinodus	..	..	..	..	..	..	..	—		
A. angulatus	..	..	—?	—	—	—	—	—		
A. Birchii	..	..	..	..	..	..	..	—		
A. Brookii	..	..	..	..	—	..	..	..	..	—
A. Bucklandi	..	..	..	—	—	..	—			
A. catenatus	..	..	..	—	—	—	—			
A. communis raricostatus?	..	..	..	..	..	..	..	—		
A. Conybeari	..	..	..	—	—	—	..	—		
A. cornucopia	..	..	..	..	..	..	..	..	..	—
A. Dudresii	..	..	..	..	..	—	—			
A. forficatus	..	..	..	..	..	..	..	—		
A. Guibalianus	..	..	..	..	..	..	..	—	—	
A. Henleyi	..	..	..	..	..	..	—	—		
A. Johnstoni	..	—								
A. obliquestriatus	..	..	..	—						
A. obtusus	..	..	..	—						
A. ophioides	..	..	..	..	..	..	..	—		
A. Planorbis	..	—								
A. planocostatus	..	..	..	..	..	..	..	—	..	—
A. Oxynotus	..	..	..	—	..	..	..	—		
A. semicostatus	..	..	..	—	—	—	—	—		
A. Turneri	..	..	..	..	..	—?	—	—?		
Belemnites, specimen of	..	..	..	—	..	..	—	—	—	—
B. elongatus	..	..	..	..	..	..	..	—	—	—
B. acutus	..	..	..	..	..	..	..	—	..	—
Nautilus	..	..	..	—	—	—	—	—		
Nautilus striatus	..	..	..	..	—	—	—	—		
Nautilus lineatus	..	..	..	..	..	—				
XI. *Pisces.*										
Scales, &c., of Æchmodus	..	..	..	—	—					
Fish remains	..	—?								
XII. *Reptilia.*										
Icthyosaurus campylodon	..	..	..	—						
Icthyosaurus tenuirostris	..	..	..	—						
Icthyosaurus communis	..	..	..	..	—					
Icthyosaurus vertebræ, &c.	..	..	..	—	—	—	—	—		
Plesiosaurus vertebræ	..	..	..	—	—					
(Coprolites of Saurians)	..	..	..	—	..	..	..	—		

REPORT

OF THE

RUGBY SCHOOL NATURAL HISTORY SOCIETY,

FOR THE YEAR 1868.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."—*Bacon.*

RUGBY:
W. I. TAIT AND SONS, ALBERT STREET,
1869,

PREFACE.

In giving our second annual Report to the Rugby World, we feel conscious of the many points in which we have fallen short of that we almost undertook to do in our last report.

In working out the Natural History of Rugby, some of our sections, pre-eminently the Geological and Botanical, have been very vigorous; but in what seem the true naturalist's more special departments—in the observation of animals and not plants, of living beings and not dry bones—we can report little progress.

Our meetings, it is true, have been largely and constantly attended, and the members proper have borne their own share in the papers read, but the Editing Committee feel that, for the prevalence of papers on Geology and Botany over those on other subjects, the Society and not the Editors are to blame.

Our registers, both of Birds and Insects, are conspicuous by their incompleteness, and do not show any devotion on the part of the sections to the interests of the Society.

To stimulate these interests in particular the Society thought right to offer a prize for Essays, written in the Christmas holidays, on any subjects connected with Natural History, with the understanding that great weight would be assigned to original observations. This prize has been awarded by the Committee to N. Masterman, for an Essay on English Snakes and the Slowworm.

To have lost, in the course of the year, the heads of all our sections—E. Cleminshaw, F. C. Selous, H. C. L. Reader, and G. B. Longstaff—may well fill us with dismay. Their places cannot hope to be worthily filled without a considerable struggle.

It is often noticed that School Societies do not survive their founders, or if they live on in a declining state through another generation, die in the third; such has been the fate of more than one Rugby Magazine, and (*absit omen*) more than one Debating Society; but our position in the eyes of a larger world than that of Rugby demands that this shall never be the case with the Natural History Society. The King can never die, says the Proverb; our Society can never even think of it.

In the re-arrangement of our various collections of English Lepidoptera, good progress was made by G. B. Longstaff, but he was not able to complete the work.* Does no one wish to embalm his memory in camphor pill-boxes, before he leaves us?

On the subject of a Museum, Dr. Hooker, of Kew, in a letter of advice to the President, says, "Local collections should be as full and complete as possible, and nothing else admitted but useful types, well ticketed, and so disposed as to be instructive." Our Rugby collection of plants is fairly complete, and we hope soon to have it separate from the rest of the British collection. But very few of the insects are Rugby specimens; cannot our incipient collectors supply us with good and authenticated Rugby specimens?

The interest taken in the Society by Old Rugbeians and others is increasing. Letters of approval and encouragement have been received from Mr. Preston, of Marlborough, from Mr. Baxter, of Oxford, and others. In order to admit Old Rugbeians of all standing, rules for the admission of Corresponding Members have been formed, and with good results; and among other signs of our notoriety, we may mention, that while this report has been in press, a collection of New Zealand plants has been sent to us from Otago by a complete stranger, a pupil of an Old Rugbeian.

We commend the Society to a new year's labours.

F. E. K. J. H. D. J. M. L.

---

* This Collection is at present at the President's house, where it can be seen by the Members on all half-holidays.

RULES.

1. That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

2. That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

3. That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding, Members; that Present Rugbeians (having attended as a visitor three of the Society's Meetings) be eligible—if in the Upper School or Sixth, as Members, if in the Middle or Lower School, as Associates.

OF OFFICERS :—

4. That the Society's Officers consist of a President and Secretary, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

5. That all Officers be elected annually.

6. That when any Office is vacant, the Committee do recommend a Member or Associate, or (for the Office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

7. That the President take the chair at all Meetings, but have no vote except in cases of equality.

8. That the Secretary keep the Minutes of the Society's proceedings; keep a list of all persons present at each Meeting; keep a list of the existing Society, with the names and addresses, as far as possible, of all corresponding Members, and a list of all Benefactors of the Society.

9. That the President and Secretary form a Sub-Committee, for managing the finances and keeping the property of the Society.

10. That the duty of the several Album Keepers be to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in his Section during the year.

11. That in the absence of any Officer, the Committee appoint a Deputy.

OF HONORARY AND CORRESPONDING MEMBERS :—

12. That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

13. That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but be required to pay for the Society's reports, for a supply of which they may pay a composition of 10s. for six years.

14. That Members or Associates, on leaving the School, become Corresponding Members without election.

OF MEMBERS AND ASSOCIATES :—

15. That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

16. That there never be more than 20 Members, or more than 20 Associates.

17. That Members pay a Subscription of 2s. 6d. per Term, and Associates of 1s. 6d. per Term.

18. That Members may speak at all Meetings of the Society; may read Papers, with the leave of the President; may introduce four visitors at all public meetings, and receive a copy of the Society's Report.[*]

19. That Associates may attend at all public meetings; may speak, and read papers with the leave of the President; and receive a copy of the Society's Report.

20. That Associates, on reaching the Upper School, do not become Members without election by the Committee.

21. That any Member or Associate may be suspended or expelled from the Society, by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

OF MEETINGS :—

22. That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

23. That Visitors may speak and read papers at all public meetings, with the leave of the President.

OF REPORTS :—

24. That a Report be printed once a year, or oftener if the Committee think fit.

25. That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

OF NEW RULES :—

26. That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any name be submitted to the Committee for Membership or Association, or any vote of suspension or expulsion passed.

27. That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

---

[*] In consequence of the expense of the Lithographs supplied with this Report, the charge to Members for this year only will be 1s., to Non-members 2s. 6d.

LIST OF THE SOCIETY IN 1868.

OFFICERS :—

President : Mr. F. E. KITCHENER.
Secretary : J. H. DAVIES.

ALBUM KEEPERS :—

Botanical, { H. C. L. READER. F. R. SMITH.
Entomological, { G. B. LONGSTAFF. J. M. LESTER.
Geological, { E. CLEMINSHAW. J. D. LAWE.
Zoological, { F. C. SELOUS. N. MASTERMAN.

EDITORS :—

Mr. KITCHENER.
J. H. DAVIES. J. M. LESTER.

HONORARY MEMBERS :—

Rev. Dr. TEMPLE.
Rev. C. ELSEE.
Dr. FARQUHARSON.
Dr. HELM.
Rev. T. N. HUTCHINSON.
Mr. KITCHENER.
Mr. SIDGWICK.
Rev. C. J. E. SMITH.
Mr. WILSON.

CORRESPONDING MEMBERS :—

A. C. BRUCE.
E. P. KNUBLEY.
P. MAHONY.
W. C. MARSHALL.
W. C. EYTON.

MEMBERS :—

E. CLEMINSHAW.
G. B. LONGSTAFF.
J. S. MASTERMAN.
H. C. L. READER.
F. C. SELOUS.
J. H. DAVIES.
J. D. LAWE.
J. M. LESTER.
J. P. BAYNES.
F. LEFROY.
W. H. PIKE.
H. G. WAUTON.
N. MASTERMAN.
R. E. BAYNES.
J. M. GORDON.
V. ELLIS.
H. POWELL.
G. A. OGILVIE.
C. T. CLOUGH.
H. WILMER.
A. NAPIER.
J. ARMITAGE.
R. F. BOYD.

ASSOCIATES :—

F. R. SMITH.
W. SUTCLIFFE.
E. W. PREVOST.
J. CURRY.
F. C. BAYARD.
J. L. BOYSON.
L. MOBERLY.
O. LEGGATT.
T. D. RALLI.
H. P. DAVIES.
J. D. ANDERSON.
H. A. BULL.
R. DUFF.
H. W. SANDERS.
T. RIVINGTON.
G. H. HARRIS.
D. A. OGILVIE.

THE SOCIETY IN ACCOUNT WITH THE TREASURER.

Dr.	£	s.	d.	*Cr.*	£	s.	d.
To Cost of Reports distributed gratis	7	0	0	By Balance on January 1st, 1868	4	12	1
" " " Boxes for Insects	2	2	9	" Lent Subscriptions	2	5	0
" " " Books and Binding		17	6	" Easter "	2	11	6
" Advanced to Printing Fund (see below)	1	3	4	" October "	2	4	0
" Balance in Treasurer's hands	1	9	0	" Two Honorary Members	1	0	0
	£12	12	7		£12	12	7

PRINTING FUND IN ACCOUNT WITH THE SOCIETY.

	£	s.	d.		£	s.	d.
To Printer	18	10	0	By 50 copies sold by Printer	5	8	4
" Postage		1	8	" 40 " " " President	5	0	0
				" 38 " given to Members	4	15	0
				" 18 " given away by Society	2	5	0
				" Balance due to Society	1	3	4
	£18	11	8		£18	11	8

The section at the bore hole, when compared with this, seems to indicate that the depth of these lime stones at the Watertower is about 220—290 feet, but our copy of the bore hole section is not sufficiently minute in its details to make an exact identification possible. It would be a valuable work to compare this with a detailed section at the bore hole, and identify the strata if possible.

J. H. Davies then read a Paper " On Sensitive Plants :"—

The subject on which I am now going to address you, namely, that of Sensitive Plants, is one which has lately attracted much notice in the scientific world, owing to the able researches of two French Botanists, M. Bert and M. Blondeau. The experiences of M. Bert, perhaps the most important memoir yet issued on this subject, appeared in the Fourth Volume of the *Memoires de la Société des Sciences Physiques et Naturelles de Bordeaux*, while those of M. Blondeau appeared in the *Comptes Rendus* for the past year. I hope to be able to give a brief sketch of what is known as to the movements of those plants specially termed Sensitive Plants ; as well as of those more general movements which, from being so familiar to us, attract but little of our attention. Such are the elevation and depression of the leaves, according as they are "awake" or "asleep," the folding and unfolding of the flowers, the movements shewn by tendrils and climbing plants, to which the researches of Mr. Darwin have drawn so much attention ; and lastly, the movements observed in the stamens and pistils of plants for the purpose of fertilization ; all which are effected by the same means as the Sensitive Plants proper, though the circumstances under which they act are generally different.

To take first these Sensitive Plants proper. They are apparently so called from the fact that the motions they exhibit are due to mechanical agency, such as the touch of a finger or some other object, a puff of wind, &c. The *Leguminosæ* and the *Oxalidaceæ* are the families in which we find most of these plants ; and we can trace the connection between these two families in the fact that both have compound leaves, that is, leaves divided into secondary leaflets. *Mimosa pudica* and *Mimosa sensitiva* are the two Sensitive Plants most generally grown in this country, and they belong to the family *Leguminosæ*. In either of these a slight touch on any one leaflet causes a folding up of that leaflet, then of the next, and so on till, if the touch be strong enough, all the secondary leaflets on one side are folded to their opposite leaflets on the other, and the petiole of the whole leaf soon droops by the stem of the plant. The same movement occurs in these two plants as night comes on, and in the morning the leaflets resume their proper position. We have in these two a strong proof that the phenomenon is not due to the intensity of the light, as the movement of "awaking" in the morning is done under a much less powerful light than that of "going to sleep" at night, for the plant closes very early in the evening and awakes very early in the morning.

The Indian Telegraph Plant (*Desmodium gyrans*) is a striking illustration. Its compound leaf consists of three leaflets,—a terminal one, and two lateral ones. The terminal one, which is the biggest, bends up and down according to the intensity of the light, but the two side ones have quite a different motion. Suppose one of them to be in a horizontal position ; if watched, it will be seen to rise, by a series of little jerks, to the vertical ; number two will then begin to descend to the horizontal ; and number one will rest till number two again arrives at the vertical, when it will descend ; and so they go on, up and down, by day and night. Some foreign species of the *Oxalis* family have sensitive motions, but they all have long pinnate leaves, like the Mimosa or the Acacia, and not the shamrock leaf of our Wood Sorrel (*Oxalis acetosella*). The *Oxalis* was known to old Botanical writers as the "*Herba sentiens*," and they considered it able to test good from bad. In the presence of vice it would droop its leaves, while in the presence of goodness it kept them horizontal.

The motions of *Dionæa muscipula*, or Venus's Fly-Trap, are also very remarkable. The plant grows in the sandy bogs of Wilmington, North Carolina. Each leaf bears an appendage at the end of it, in shape like a steel trap, and acting very much like one. It is usually open when the sun shines, and no sooner does an insect brush against one of the long hairs on its surface, than the trap closes, and commonly kills the intruder. For what purpose this plant catches flies we cannot pretend to say.

The *Drosera*, or Sundew, is the nearest resemblance to Venus's Fly-Trap that we have in this country. It has the power of catching flies on its leaves, which are hairy, and covered with a sticky substance, but it cannot shut up upon them.

In the flower itself, the stamens and pistils of several flowers can be excited to mobility by mechanical stimulus. For instance, in the Berberis, a slight touch with a pin, or with the antenna of an insect, will cause the stamens of the flower to bend inwards near enough to the stigma to deposit their pollen on it. In the *Oxalis acetosella*, the seed vessels, as soon as ever they are ripe, burst open, scattering their seeds in all directions, and the three carpels only are left there. The same action occurs in the Balsam, which has the significant name of *Impatiens noli-me-tangere*.

So much for the description of the Sensitive Plants, and now to find the cause. It is found by the anatomy of the part of the plant whence springs the mobility. This is generally allowed to be the cellular tissue. In the stems of those plants which possess the greatest sensibility, we can almost always find, at the base of the petiole, a little swelling (known to the French as the *coussinet*), the structure of which, on microscopic examination, appears to be as follows: in the centre some pith cells; outside these a ring of fibro-vascular tissue; again outside these, three or four layers of cells containing,—the inner ones starch, and the outer ones chlorophyll; then a ring of cells, also filled with chlorophyll (which is a green substance, from a slight modification of which indigo is produced); and investing this is the ordinary epidermis, destitute of stomata. The order is pith, fibro-vascular tissue, cells of two kinds, epidermis. It has been found by experiment that if, in a transverse section, the cellular tissue be separated from the fibro-vascular portion, by means of cutting it away all round the central cord, the cellular tissue springs out into the hole thus made, becoming lengthened; and hence, while it remained attached to the central cord, it must have acted as a spring above and below, so that, as long as it maintained its equilibrium, the leaf kept horizontal, but when, by the superior energy of the upper, or the diminished force or temporary paralysis of the lower spring, the equilibrium was lost, the upper one was able to press down the leaf, and keep it down till a renewal of force in the lower spring raised it again to the horizontal. What is shown by the anatomy of the *coussinet*, or swelling at the base of the petiole, is, then, that certain fluids, rushing from one lot of cells to another, and swelling out these last, cause the movements observed. We must now notice the causes that set liquids in motion. A touch with the finger or any other object, a puff of wind, a drop of water, even a footstep, in their native country is sufficient to set them in motion. From experiments it appears that they get more or less accustomed to these influences, and so in time lose their sense of mobility. In instance of this, Desfontaines carried a Mimosa about with him in his carriage; at first it moved as usual, but, after a time, it ceased to respond to the stimulus. Dr. Maxwell Masters, in an article on this subject in the *Popular Science Review*, says that the same thing occurs if a plant be carried by railway. With regard to the chemical experiments that have been made with these plants,—it has been found that if a drop of ether be let fall on the leaf of a Mimosa from a height of five or six inches, the instant contraction of the leaflet on which it falls, and then of the rest in succession, takes place; if, however, the ether be gently placed on the leaflet, it seems paralysed, and does not move; the rest of the leaflets, however, move as in the former case. Opium and chloroform act with a paralysing influence, while strong acids cause instant contraction. M. Blondeau submitted three plants of the Mimosa to a Ruhmkorff's coil. The first he acted on for five minutes; after a quarter of an hour's prostration it recovered, and opened its leaves. The second he acted on for ten minutes; after an hour's prostration this one slowly revived. But the third, after 25 minutes' galvanisation, never recovered, but in 24 hours had the appearance of a plant struck by lightning. These are all new experiments, which were made only last year, by men of science interested in this subject.

We will now turn to that sensitiveness of plants, so commonly before our eyes, but so little noticed; such as the sleep of plants, and the climbing powers of the tendrils. With regard to the phenomenon of plants being awake or asleep, we are all familiar with many instances. The *Oxalis acetosella*, or Wood Sorrel, is a good example: though it belongs to a family in which Sensitive Plants abound, it is itself insensible to mechanical agency, but at night may be always observed to droop its leaves. The Locust does exactly the same, Asa Gray says; while the Honey Locust raises them upright, instead of drooping them. The Acacia does the same as the Oxalis, and so does the Chick-weed, a plant which we can all easily observe for ourselves. The way in which the blossoms close,—some when light increases, some when it decreases, illustrates the same thing.

With regard to climbers I must speak but briefly, as the subject is one large enough for a paper of itself. Mr. Darwin's enquiries into the subject, which can be found in the *Journal of the Linnæan Society* of June, 1865, are extremely interesting. The climbers with which we have to do, from their sensitive properties, may be well divided into three divisions,—Spiral Climbers, Leaf Climbers, and Tendril Climbers. There is another division of climbers, namely, that of Root Climbers; but with this we have nothing to do, as their rootlets do not appear to be at all sensitive.

Spiral Climbers, of which a very good illustration is the Hop, are those which twine round everything they meet. The shoots of these plants go round and round in a circle, till they meet something they can twine round, and then they start round and round again, only making what was the impediment before their centre of motion now. Mr. Darwin's record of the Hop's revolutions is extremely interesting. He gives the exact number of minutes in which each revolution was made, showing that the velocity of the plant's motion increased each round, till the 36th and last was done in 2 hrs. 8 min., while the second took 9 hrs. At the end of the 36th round, the shoot's power of motion was worn out, and it became rigid and upright. He mentions the case of another Asclepiadaceous plant, the *Ceropegia Gardnerii*, a shoot of which, 31 inches in length, revolved in a course opposed to the sun—(the Hop moves with the sun)—at a rate between 5¼ and 6¾ hrs. The older internodes of the plant are often unable to twine round a stick unless it is a thick one, so much have they lost their sensitive property.

Leaf Climbers are those which climb, either by the petioles of their leaves, or by the produced midribs or tips of their leaves. Of these the Clematis and the Tropœolum are the best instances I know. These plants, whenever they meet anything to assist them, bend round it with their leaves or petioles, and by this means ascend higher. The petioles and tips of the first-formed leaves are often found not to be sensitive. Upon examination of several species of both Clematis and Tropœolum, it will be found that in the former the highly sensitive leaves, with their petioles, have rendered the internodes unnecessary, which have therefore become enfeebled; while in certain species of the Tropæolum, both the spontaneous movements of the internodes, and the sensitiveness of the petioles, have been enfeebled.

By Tendrils are meant the filamentary organs sensitive to contact, and used only for climbing. The *Papilionaceæ* are a particularly illustrative family of this kind of climbing. Every one knows the tendrils at the end of the general petiole of the leaf of our garden Sweet Peas. The Virginia Creeper is another good example; and it is particularly well adapted for climbing, for when its tendrils can find nothing on a wall or the bark of a tree to catch hold of, their tips expand to a flat disc, which adheres very firmly to a wall or bark.

Very striking illustrations of the sensibility of plants are also found in the ways of fertilization. We have already noticed how in the Berberis the touch of the antenna of an insect causes the stamens to bend forward near enough to the pistil to deposit their pollen on the stigma. In the *Vallisneria spiralis*, a South-European species of the *Hydrocharis* family, the small pistillate flowers grow at the top of the water, while the staminate grow at the bottom, but when the pollen is ripe, they break off from the plant and float to the surface, where they fertilize the stigmas. The *Utricularia*, a plant which, I believe, Mr. Kitchener is vainly endeavouring to find in the neighbourhood of Rugby, also exhibits a curious motion. It grows from the bottom of the water, the top of the plant keeping itself about the middle of the water until the very fine weather. This is effected by its utricules, or little bladders, which are filled with a thick liquid. When the fine weather arrives, these utricules cast out the thick liquid, fill themselves with a light gas, and float to the top, where they blossom. When bad weather returns the reverse motion takes place. The bladders again open, emit the gas, take in the thick liquid, and descend.

In the stamens of the nettle we find an elasticity which is remarkable. While the plant is closed they bend forward, with the anther bent as low as their filaments; but, when the flower opens, they immediately spring back again, with an elastic motion.

From what has been said, it is evident that we have still very much to learn as to the causes of the movements observable in the vegetable world. We know that the nocturnal movements are caused by a gradual increase of force in the upper spring, accompanied at first by a diminished, subsequently by an augmented, force in the lower portion of the *coussinet*. On the other hand, the mobility that follows on excitation is due to a loss of force in the lower portion of the *coussinet* only, though how this is effected remains a mystery. One thing these movements do seem to point at, namely, that the frequent assertion that plants are distinguished from animals by their having no power of motion, is a fallacy. It should rather be said that plants acquire and display this power only when it is of advantage to them: but this is a comparatively rare occurrence, as they are affixed to the ground, and food is brought them always by the wind and rain. When, however, we look at one of the more striking of these Sensitive Plants, we cannot fail to see to what a high scale of organisation they are endowed with the power to rise.

42 persons were present.

MEETING HELD MARCH 21ST, 1868.

THE Exhibitions were :—Lias Fossils from the new pits at Lower Hillmorton; *Montivaltia* from Hillmorton (new locality), &c.; by E. CLEMINSHAW. Shilling of Philip and Mary, found in the panel of an old door; and Gall on Willows; by the President.

A vote of thanks was passed to G. E. Fryer, Esq., for a Donation of Books.

The President read some notes "On Birds'-nesting, its uses and abuses."

A Lecture was then given by G. H. Helm, Esq., M.D., "On the Circulation of the Blood," illustrated by Diagrams lent by Professor Humphry.

51 persons were present.

Meeting held April 4th, 1868.

The following Exhibitions were made:—Daisy with coherent peduncles; by the President. Hybrids between cowslips and primrose; by Mr. Wilson. Specimens of *Primula elatior* (*Jaques*) from Suffolk; by Mr. Kitchener; Keroscene Shale from Newcastle, New South Wales; Gold Quartz from Australia, and other Minerals, sent to the Arnold Library by Mr. S. J. Holland (o.r.) Vertebræ of *Plesiosaurus* from Victoria Works, and Scales, &c.; by E. Cleminshaw. A portion of the Atacama Meteorite, of Meteoric Iron enclosing Olivine; by Dr. Flight. Various Microscopic Objects; by W. Beck, Esq.

A Paper was then read by E. Cleminshaw, "On the Volcanoes of the Lower Eifel Mountains."

Last summer, when travelling on the Rhine, I paid a short visit to the volcanic district of the Lower Eifel, near Andernach, and I wish to make a few remarks on the specimens of volcanic products I have to exhibit from that district.

The range of the Eifel extends along the north bank of the Moselle, which joins the Rhine at Coblentz; it commences near Trèves, and ends at the Rhine. It is divided into two parts—the Upper Eifel, the most western; and the Lower Eifel, bordering on the Rhine. It is about the latter that I am going to speak. From Coblentz to Bonn the Rhine flows through a district in which volcanic action has been largely developed. On the west bank is the Eifel, and on the east the basaltic district of the Westerwald, and the range of the Seven Mountains near Bonn. The fundamental rocks of this region are Devonian slate-rocks and sandstones, containing fossils in places. Through this rock a great many lava currents have burst forth in the Westerwald at a remote period, the lava being chiefly basaltic lava and trachyte, few ashes seeming to have been ejected. Many of the hills of that neighbourhood are capped with basalt, and the cliffs along the Rhine in many places consist of rude basaltic columns; the "Seven Mountains" mostly consist of trachytic lava.

Passing to the western side of the Rhine we come to the Eifel. Now this is of a different type to the Westerwald lava streams, and it was of a later date, for its effects are more apparent to the eye. The eruptions took place through the Devonian slate-rock and sandstone, sometimes on an elevated plateau on the side of a hill, or in a valley. But differently from the eruptions in the Westerwald, great showers of pumice, ashes, scoriæ, etc., preceded the eruption of lava. A small cone was formed of the ashes and other ejections, and then a small stream of lava would burst out, sometimes at the base or on the side.

These ejections of pumice and ashes are associated in an interesting manner with the alluvial deposit of the Rhine called "Loëss." This Loëss is a sandy loam, of a dusty colour, containing in places terrestrial and freshwater shells of recent species. In some places it has been deposited on an enormous scale, especially between Bingen and Bâsle. It was probably caused by an oscillation in the land, the land first sinking, so that the river would deposit its alluvium high up the valley; on the raising of the land, the river would re-excavate its channel. The gorge which extends from Bingen to Bonn is somewhat broken into by a plain stretching between Andernach and Coblentz, about six or eight miles. This is sometimes called the "Basin of Neuwied," for it was probably a large lake; and it is covered with a thick deposit of Loëss. The Loëss here, however, is found to be interstratified with beds of pumice, ashes, and volcanic sand, implying that the last eruptions of the Eifel took place at the time of the deposition of the Loëss. The amount of pumice which is found round Neuwied is something astonishing, the ground being in some places composed almost entirely of pumice and volcanic cinders.

Starting from Andernach early in the morning towards Laach, I soon saw evidences of volcanic action. Some men were making a new road through some rising ground just behind the town, and the cutting they had made exhibited very distinctly the interstratification of the pumice and ashes with the Loëss. The sides of the cutting were composed of distinct layers of alluvium and ashes. The pumice, sand, and ashes seem to have been showered over the district, and then to have ceased, and allowed the Loëss to be deposited quietly. After an interval, another ejection of pumice would take place, and another layer of ashes be deposited; and so on till a thick mass of alternate layers had been deposited. I could trace this formation distinctly, nearly up to the hills surrounding Laach, the ground being dry, dusty, and thick with cinders. All the country I passed through between Andernach and Laach was gently undulating; two or three small volcanic cones might be seen rising up out of the plain.

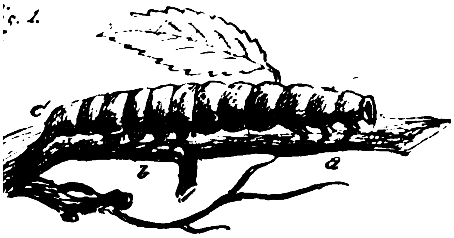
The first hills I came to were composed of slate rock, and there was a slate quarry on the road, and no traces of volcanic action could be seen at hand. Here I may mention a noticeable peculiarity in most of the Eifel volcanoes. When walking among the hills, in places you would scarcely have any suspicion that you were in a region where volcanic action had been going on,—hard sandstone and limestone rock is on both sides of you: but go on a little further, and you will find that the ground changes: it is now composed of sparkling volcanic sand, and scoriæ and volcanic stones are lying about; and almost before you are aware of it, you find yourself on a small volcanic cone wooded almost up to the top, and probably a rugged stream of lava may be seen. These lava streams are generally basaltic, and generally small: in fact the amount of lava ejected through the Eifel, is not in proportion to the pumice and ash. Great evolutions of gases also seem to have taken place occasionally, and to have carried away a large part of the cone, and scattered its contents over the adjoining country. In many places the eruption seems confined almost to pumice, ashes, scoriæ, stones, and the evolution of gases, the lava current being an afterthought. Passing on through wooded hills and over volcanic ground, I soon came to the celebrated lake of Laach. This is about the most beautiful of the tarns in the Eifel: it is circular, and of a deep blue colour: it is almost surrounded by thickly wooded steep cones, which are composed of scoriæ, ashes, slag, and sand, and two or three small lava currents can be traced down their sides. Many of the tarns in the Upper Eifel are the true craters of volcanoes, which have been filled up with water. The lake of Laach is however of a different character: it is not a true lake-crater, but has been made by the formation of the numerous cones around it. Its shores are composed of volcanic sand, pieces of slag and scoriæ, and burnt shale and sandstone.

A little to the S. W. of Laach, a considerable stream of lava is found at Niedermendig, covered thickly with pumice and alluvium. It is of rude basaltic character, and from its extreme hardness is extensively quarried for millstones, for which it has been used ever since the time of the Romans. This Lava current cannot be distinctly traced to any vent, and this is characteristic of many of the lava streams that they have burst forth at the foot or sides of volcanoes. Several other streams can be traced near Mayen. From the summit of the cones on the East side of the lake I had a good view over the country between the Upper and Lower Eifel, and I could see many pointed cones, and a tall one near the lake, called "Veitskopf," with a good stream of lava to be traced down its side. Leaving the beautiful Laach Lake, I turned again down a valley which led to the Rhine again, at Brohl. The ground still continued volcanic, and I passed several small cones, one capped with rude basaltic lava, and a broad stream of it running down the whole of one side, in large rugged blocks. Another valley from a volcanic mountain, called Olbrück, joined the one I was walking down. The volcanic nature of the ground gradually ceased, the sides of the valley became steeper, and the romantic Brohthal commenced. This Brohthal, which opens on to the Rhine, is a beautiful, narrow, winding valley, watered by a considerable brook; it is celebrated for a peculiar and interesting deposit, called Trass, which is found plentifully in it. It is a soft dusty coloured stone, very porous, and much veined with pumice and ashes; when pounded and mixed with lime, it possesses the property of hardening under water, and is much used for the dykes in Holland. At the bottom the deposit consists of pumice, with fragments of lava, burnt shale, and slate, and also carbonized trunks of trees. This bears a resemblance to the interstratified Loëss and pumice, but the Trass is mixed up together and the former is not. It was probably formed about the same time, but must have had a different origin. The explanation Lyell gives in the *Elements* is the following:—He supposes a copious evolution of gases in one of the lake basins. The water would remain for weeks in a violent state of ebullition, and become of the consistency of mud, as the sea did round the newly-formed Graham's Island in the Mediterranean, in 1831. If a breach should be made in the side of the cone, a flood would sweep down into the vallies, carrying with it pieces of shale and sand-stone and ejected materials; such a flood would carry with it any trees it might meet with. Plants also of recent species are sometimes found in it. The Trass has been excavated by quarries and the stream, and now forms fantastic and picturesque crags and pinnacles. In some places it is nearly 50ft. thick.

The signs of volcanic action have not quite deserted the Eifel. Near Laach there is said to be a deep hole, in a bed of clay, which gives off carbonic acid gas; and small animals are sometimes found in the clay, which have been killed by the noxious vapours. There are many hot springs also throughout the Eifel, especially the Upper Division of it; and mineral springs are very numerous. I passed through one village, in which every one of the springs I saw was most distinctly mineral in its character.

If we consider the probable age of all these eruptions, we shall find that they extend over a long period. We find the eruption which formed the Seven Mountains, associated near Königswinter, with a bed which is referred to the Brown Coal formation, which is of middle Tertiary age, and was deposited soon after the chalk. In all probability the eruptions continued from about that time, till a period which is, Geologically speaking, quite recent, but far

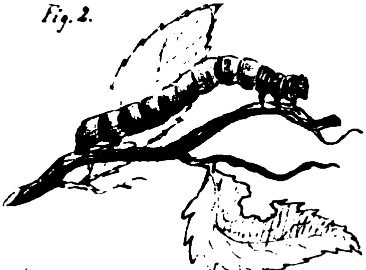
ig. 1.



Type of caterpillar of Moth or Butterfly

a = legs
b = ventral claspers, or prolegs
c = anal claspers, or prolegs.

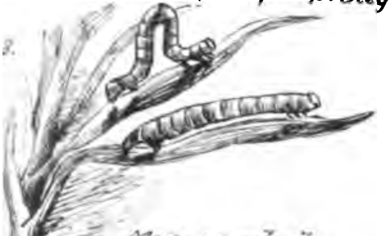
Fig. 2.



Caterpillar of Geometrous Moth.

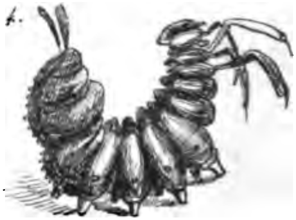
a = legs
b = claspers, or prolegs

3.



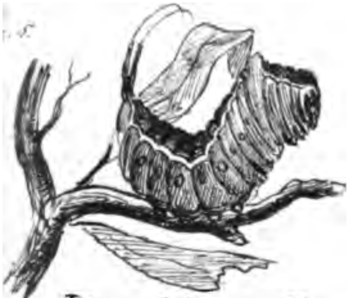
Mode in which Geometrous larvae walk.

Fig. 4.



Larva of Lobster-moth, Stauropes Fagi, showing the enlarged legs and the two anal appendages.

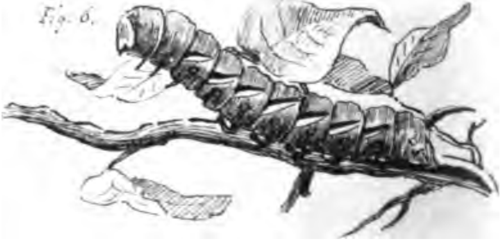
. 5.



Larva of Puss-moth attitude when alarmed

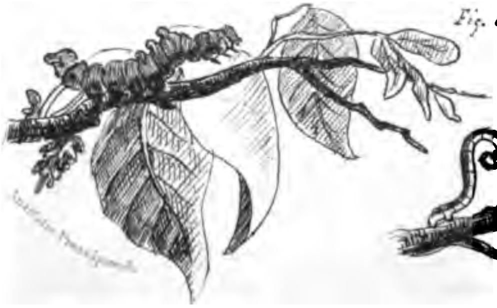
a = appendages which supply the place of anal claspers.

Fig. 6.



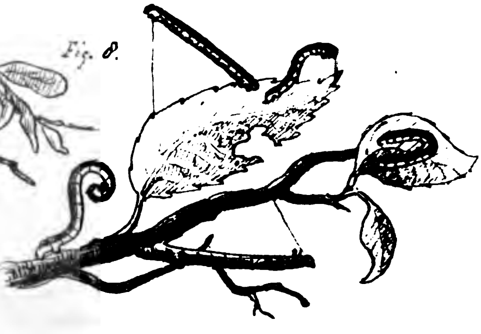
Larva of Privet Hawk-Moth at rest.

. 7.



Larva of Notodonta Ziczac, Prominent Moth, at rest.

Fig. 8.



Various positions of Geometrous Larvae, at rest.

beyond the Historical Era. The Lower Eifel was probably the most recent of these eruptions, for we find them associated with the Loëss, which was quite a recent deposit, and there are no traces of it after that period. The currents of lava also conform to the present configuration of the country.

I hope that the few remarks I have made on the Lower Eifel and its volcanoes, may induce some member of this Society, who happens to be travelling in that neighbourhood, to pay a visit to the Upper Eifel, and make a better examination of it than I was able to do of the Lower Division, and give the Society the benefit of his observations at some future meeting.

62 persons were present.

MEETING HELD MAY 9TH, 1868.

AFTER various private business, the following Exhibitions were passed round:—*Eryon Wilmcotensis*, Insect wings and plants, from base of Lower Lias, near Stratford; by E. CLEMINSHAW. Various kinds of Bitumen, and Oxide of Manganese; by the Rev. T. N. HUTCHINSON.

A Paper "On Caterpillars," by G. B. LONGSTAFF, was read, in his absence, by the Secretary.

ONE of the most interesting things in the pursuit of Entomology is the observation of the varied structure and habits of the caterpillars, or larvæ of butterflies and moths. Their colour and variety of form are almost infinite; and nearly every plant on the face of the globe affords food to one or more species, and their habits are, in many cases, no less strange than their forms.

I will first say a little of their exterior structure. Caterpillars, as a general rule, are composed of 13 rings or segments, the head counting as the 1st; the 2nd, 3rd, and 4th segments are in nearly all cases each provided with a pair of legs or claws, making six legs in all. Besides the legs, they possess members to which the name of prolegs, or claspers has been given; they are not true legs, but are flaps provided with suckers, by means of which the creatures are enabled to cling tightly to their food, and to ascend walls and trees with ease. These claspers are usually 10 in number; four pairs are placed on the ventral segments, and one pair on the last, or anal segment. This drawing* [Fig. 1.] will shew the general structure of a caterpillar. A large class of moths (called, from the curious manner in which their larvæ walk, *Geometræ*) possess only four of these claspers, which are placed on the two last segments of the body. The drawing Fig. 2. represents a larva of the Geometrous type. The mode in which Geometrous larvæ walk is very curious. They seize firmly the substance on which they stand with their two pair of claspers; they then stretch the body out as far as possible, and catch hold of something with their forelegs, or true legs, then they leave go with their claspers, and draw the body up towards the head, and seize hold of the stem or leaf on which they are walking, with their prolegs, just behind the part where their legs are holding. This will be better understood by Fig. 3.

Caterpillars breathe through small holes in the sides of the segment, called spiracles; they appear to the naked eye to be small dots, and are often of brilliant colours.

The legs of caterpillars are in some cases modified, thus—The larva of the Lobster-moth (*Staurŏpus fagi*) has the second and third pair of legs very long, and instead of the anal claspers it has a pair of very short tails. Fig. 4

---

* The drawings were prepared for anastatic printing by J. O. Anderson.

represents this larva. In the case of the Puss-moth larva, the anal claspers are replaced by a pair of long tails, from which the caterpillar, when alarmed, can put forth two long, red, hair-like tails, with which it touches that part of its body which has been hurt, at the same time it raises its head into the air. It has been supposed that the object of these tails is to drive away Ichneumon flies, which lay their eggs in the caterpillar, and produce grubs, which eat the caterpillar, and cause its destruction. The attitude of the Puss-moth larva when touched is shown in Fig. 5.

The skin of most caterpillars is quite smooth and soft; the caterpillar of the Poplar hawk, however, has a rough skin, resembling shagreen: many caterpillars have humps and warts of various shapes on their bodies: the larvæ of the Hawk Moths have in most cases a long horn on the last segment. Then again, while most caterpillars are destitute of hairs, many very common kinds are densely clothed with hairs. The common Tiger caterpillar for instance *(Arctia caja)*. The hairs of the Gold-tail *(Liparis auriflua)* and of the Drinker *(Odonestis potatoria)* cause great pain and intense itching when they get into the skin. The caterpillar of the Vapourer moth *(Orgyia antiqua)* has several dense tufts of hair on its back, and also three long tufts of clubbed hairs, which give it a very curious appearance. The tufts are of a yellow colour, and the long clubbed hairs black, and the body of the caterpillar is marked with red and black, so it is a very pretty one.

Now referring to the habits of larvæ, we will first consider the modes of resting peculiar to various species. Most of the hairy caterpillars rest perfectly exposed on the surfaces of leaves, merely stretched out at full length. The larvæ of the Hawk-moths rest in a very curious position. This drawing [Fig. 6] represents the handsome fat larva of the Privet hawk-moth *(Sphinx ligustri)*, which, after having stripped the twig on which he stands, proud of his accomplishment and tired of eating, raises the fore-part of his body superbly into the air, and goes to sleep. One of these larvæ can scarcely be shaken from his perch when in this position, for he grasps the twig very tightly with his claspers. Linnæus, when in one of his fanciful moods, thought this attitude like the attitude of the Egyptian Sphinx, hence this tribe of moths was called by him *Sphinges*.

One of the most extraordinary positions of rest, and one that looks excessively uncomfortable, is that of the Prominent-moth. It raises the anal segments into the air, and the fore-part of its body is lifted up and bent in a very strange manner. From its shape when at rest it has been called *Notodonta ziczac*. It has also three very curious humps on its back, and its brown colour and its attitude make it look very much like a shrivelled dead leaf. Fig. 7 represents it.

The ten-legged caterpillars of the *Geometræ* rest in very various positions. Some stretched out and quite stiff, some bent, and some curled up almost into the shape of a note of interrogation. In all these cases the Geometrous larvæ only retain their hold by the anal claspers, and are attached to the leaf by a thread of silk, by which they hang if shaken from their post. In some cases they rest bent in such a manner that their heads nearly touch their tails. Fig. 8 represents some of the attitudes of geometrous larvæ at rest. These larvæ, as Mr. Sidgwick remarked in his paper on "Protective Resemblances," are many of them very similar to bits of twig in their colour, and by their attitudes they add to the resemblance. From this likeness they are often called stick caterpillars.

A great number of the green caterpillars rest stretched at full length along the midribs or petioles of leaves.

I will now say a few words on the manner in which larvæ feed. Every part of the plant is liable to the attack of caterpillars, for some feed on the leaves, some on the wood, on the bark, the seed, the flower, the root, the pith. Some feed quite exposed; others spin two or three leaves together; many feed in the interior of the plant; a few species feed on the wax in beehives. Very many roll up a leaf and feed inside, or fasten two leaves together; while I believe one or two feed inside galls. The Clothes-moths make a covered gallery and feed inside; while a large number construct cases, after the manner of caddis worms, and walk about with them on their backs. Then one of the most interesting and most numerous classes are those minute species known as miners, which feed between the upper and lower epidermis of the leaf, eating the green portion, and making the discoloured blotches and tortuous lines so often seen on leaves.

I have this evening lightly touched on several points in the economy of caterpillars, which would furnish materials for a great many papers, and which I hope will be carefully worked out, one by one.

A few notes were read by E. CLEMINSHAW, on a Slab of New Red Sandstone presented by F. R. Smith. It showed footprints, at one time supposed to be those of the *Cheirotherium*, an unknown reptile, but now assigned by Professor Owen, from bones found in Germany and Warwickshire, to some animal of the Batrachian order, far larger than any now extant. The animal has been named *Labyrinthodon*, from markings on the teeth.

G. A. OGILVIE exhibited some Fossils from the Red Crag, Aldborough, and read some notes on the locality in which they were found.

N. MASTERMAN exhibited a Badger, recently killed in Wiltshire, and read some notes on it.

A Plan of the Close, indicating the Trees in which the Rooks had built this year, was exhibited by J. M. LESTER.

At a Private Business Meeting, Associates were made eligible to hold Offices.

39 persons were present.

MEETING HELD MAY 23RD, 1868.

THE following Exhibitions were made:—Sulphate of Copper, crystallized at high temperature, exhibiting Prismatic colours from interference; by the Rev. T. N. HUTCHINSON. Lead Ore from Yorkshire; by E. J. NORTON. *Senecio campestris*; by Mr. KITCHENER. Roman Lamp, dug up near Lincoln; Vertebra of Whale, and part of Femur of Elephant, from the Forest Bed at Cromer; by Mr. WILSON. Meiocene and Red Clay Fossils, by G. A. OGILVIE. Andamanese Curiosities, presented to the Library by G. E. FRYER, Esq., were described by F. C. SELOUS.

A Letter from Mr. Wallace, author of the article on "Protective Resemblances," commented on by Mr. Sidgwick in the last Report,

was read by F. C. Selous. Mr. Wallace suggested that the Members could profitably observe what Caterpillars* were or were not fed upon by what Birds, with a view to showing whether they were protected specially by colour, or taste.

A Paper was read "On Reason and Instinct in Animals," by F. Lefroy.

There seems to exist in the minds of most people a deeply-rooted idea that one of the chief differences between man and brutes is, that the former acts from reason, the latter from instinct. A little consideration of the actions of animals, and the motives by which they are induced to act, will, I think, show how little foundation there is for this idea. Many of us would, if asked, deny the existence of reason in animals, and most of us ignore it. And it is this same prejudice that makes us lay so much more weight on instances where reason seems to be entirely absent, than on, I think, more frequent instances where it has been brought into action. But before giving instances on either side, let us consider what instinct really is. "Instinct," writes one author†, "is a determination given by Almighty wisdom, to the mind of the brute, to act in such or such a way, upon such or such an occasion, without intelligence, without knowledge of good or evil, and without knowing for what end or purpose he acts!" And it differs from reason, in as much as rational actions are those performed to the furtherance of a certain end or motive; or to escape from something which experience teaches as unpleasant, whilst instinctive actions, although they have a cause, namely, the internal impulse which prompts them, yet cannot be said to have a motive. It is clear, that in a more or less degree, according to his state of civilization, man shares instinct with the brutes; for instance, there is the instinct of fear, or self-preservation, and there is the

---

*** G. B. Longstaff has recorded in the Entomological Album the following cases of Protective Colouring in Caterpillars, from his own observations:—**

There is a large genus of closely-allied moths of the class Geometræ, called *Eupithecia*. The larvæ of this species feed in a very exposed manner upon the flowers and seeds of plants, and to give them security they very much resemble the flowers and seeds upon which they feed. Several larvæ of different species of this genus have come under my observation during the past holidays. Of these I may mention four species, viz.:—

First, one that feeds on ling (*Calluna vulgaris*), and is coloured with alternate patches of green and brilliant pink, which is excessively like the heath flowers. Its name is *E. Nanata*.

Second, another, which feeds on *Angelica sylvestris*, is varied with brown and pale olive-yellow, and very closely resembles the seeds of that plant. I looked once at an umbel of the *Angelica sylvestris*, and soon saw three or four larvæ, but so closely did they resemble the seeds, that after examining the umbel for several minutes I succeeded in finding 15, whereas at first sight I thought that there were only about three.

Third, one which feeds upon an umbelliferous plant, whose name I do not know, which has greenish-white flowers, with pink involucral bracts,—is coloured pink and white alternately; while the Fourth, which feeds on Ragwort, is uniformly yellow.

In the larvæ of all the species of this genus, there is a great resemblance of form and similarity of marking; but in colour they have, as we see in the above four instances, a very striking resemblance to the plants on which they respectively live.

† Author of Ancient Metaphysics.

social instinct. The former of these, of course, has, with most races of men, been much modified by the advance of civilization, and consequent increase of wealth and personal safety. But in animals it appears very strikingly. People who have laid traps for foxes in North America, tell how in many instances, after the trap has been buried in the snow, and pieces of fish scattered as bait over and around it, a fox will come, smell cautiously around, and eat the fish scattered round the trap, but at the same time studiously avoid those pieces immediately over it, and thus escape unhurt. And this instinct of self-preservation is also seen in the cautious way in which horses, going over the moors in Scotland, avoid the soft portions of the bogs.

And there is also the instinct of parental affection shared by all creatures. And there is discrimination in food, by which animals in most cases will avoid noxious food, which, however, comes under the instinct of self-preservation; as does also the fact, that where great and wanton destruction of animal life has occurred, they will avoid the place for years. The Walrus thus forsook a part of Spitzbergen; and the Reindeer permanently forsook the west side of Hudson's Bay, in 1835, in consequence of a wholesale slaughter by the Indians, in crossing York River the year before. In these instances the animals seem to have profited by experience.

Perhaps it may be said that one great evidence of the possession of reason is the ability and desire of improving one's condition; and certainly it is a well-known fact, that most animals go on building the same homes year after year, without the slightest improvement. And in some instances, there is some especial peculiarity in the making of it which instinct teaches, but for which no satisfactory reason can be found. Such for instance is the path of glittering pebbles, which the Australian Bower-bird makes round its bower, on which it struts all day, and also the bower itself, which Mr. Wood, in *Homes without Hands*, says, is not the bird's nest, but is used as a general assembly room, for not only the Bower-bird, but other birds also. Mr. Wood says this bower and path are made solely for amusement; but perhaps there is some other reason for it not yet discovered. But it is not only among the brutes that we find this want of improvement; and if we say it betokens necessarily want of reason, the same remark must apply to savages; such as especially the savages of Australia, and the Andaman Islands. But we find that as soon as civilization is introduced, they adapt their habits to their altered condition, and improvement soon appears, and instinct gives more and more place to reason. Is it impossible, therefore, that the reasoning power of animals also, when they are domesticated, and after intercourse with man, may also increase? It is certain that domesticated animals, such as the dog, horse, or elephant, show more signs of intelligence and understanding than those quite in their wild state, such as the fox or hare; but I have lately heard of an ingenious way in which a hare escaped its pursuers, namely, by creeping into a hole in an old wall, and waiting till the hounds ran by. And there is the more common instance of intelligence, in which the Hooded-gray or Royston Crow, breaks the shell of muscles and cockles, by flying to a great height, and letting them drop on the rocks. Dr. Stanley tells of a snake-eater, *Vultur Serpentarius*, of Africa, which was observed to kill a serpent in the same way, when he found it too disabled by previous attacks to make any resistance. Perhaps these instances may be merely considered as the instinct by which nature taught these animals to procure themselves food, and not as showing forethought on their part. But if this is the case, it seems impossible to put any limit to instinct; and it might almost as well be said, that the subtle way in which the North American Indian avoids his pursuers is due to instinct.

There are some extraordinary cases of instinct, which it is extremely hard, if not impossible to explain. For example, the instinct which prompts the travelling fishes of Ceylon to move about over the land in the dry season, from pool to pool. Sir Emerson Tennant says that the fish leave the pools and nullahs in the dry season, and by an instinct as yet unexplained, shape their course through the grass toward the nearest pool of water. He says that the individual most often met with in these excursions is a kind of Perch, and that their bones are so shaped as to contain a certain supply of moisture, which exudes during the journey, and keeps the gills damp; and though they generally travel by night, Mr. E. Layard once met a number of them travelling along a hot and dusty road under the mid-day sun. Here the motive of the movement of the fish is evident, but how instinct guides them from pool to pool, and from the dry ones to those that are not dry, is not so evident.

Most of the instances of intelligence we have yet considered may, however unlikely, be put down to instinct in some form or other, but now let us see if more than mere instinct is not sometimes shown. The evident means of communication which animals possess with each other, even with those of different species to themselves, seems in many instances to indicate reason and calculation. This is especially seen at the frequent meetings of Crows, Herons, small Storks, and Magpies. Dr. Stanley, in his book on birds, gives an account of a very singular meeting of Storks, that was witnessed near a small village on the banks of the Rhine, "where," he says, "in a large meadow, every autumn, the Storks assemble to hold (as the country people call it) a council, just before their annual migration. On one of these occasions about fifty were observed formed in a ring, round one individual whose appearance bespoke great alarm. One of the party then seemed to address the conclave, by clapping its wings for about five minutes; it was followed by a second, a third, and a fourth in regular succession, each like the first clapping its wings in the same odd and significant manner. At last they all joined in chorus, and with one accord fell on the poor culprit in the middle, and despatched him in a few seconds. After which, they rose up in a body, and one, according to their custom, taking the lead, flew off to the southward."

In a late number of an Australian newspaper, there was an account of some birds which were seen to attempt to rescue, in a body, one of their species which was encircled in the coils of a serpent. The struggle, which lasted for some time, was put a stop to by a man killing the serpent, when the birds with their rescued companion flew off.

And ants have been observed to congregate and communicate with each other in the same way. A gentleman once watched some ants, which, on discovering a beetle crawling along, went and collected other ants, and having assembled in a body, made a simultaneous rush, and carried the beetle away.

Now I think that in these instances, reason, intelligence, and calculation, is shown as clearly as it could be in any action of man.

A very remarkable instance of intelligence shown by a dog, though not in the same way, is told by Mr. Atkinson, in a book of Natural History written by him:—"A coach was once going along a road on a dark night at a good pace, when suddenly the horses were hindered by the incessant barking of a dog, which continued until the guard got down to drive it away; but the barking and significant gestures of the dog only increased, until at last the guard was induced to follow him. After proceeding a little way, he came to the dog's master lying drunk right across the road, and his horse standing beside him, so that if the coach had proceeded, death or severe injury to the man must have been the consequence." But the dog's intelligence prevented this. And this can certainly not be called an instance of the instinct of self-preservation, because the dog could have escaped injury easily, and all his anxiety was evidently about his master, whose life he perceived was in danger if the coach was not stopped.

And to-day I was told a well-authenticated story, of a dog who is in the habit of receiving pennies from his friends, taking them to the baker's shop, of which he knows every one in the town, getting a roll in exchange, and trotting off contented. A very similar story is told in *Jessie's Gleanings.*

But though all these examples show the intelligence of brutes, they have, like human creatures, been known sometimes to do very stupid things. And in some cases instinct appears entirely at fault. Of the former, a remarkable instance was lately noticed, and I believe not published. A Sparrow, seeing a lot of shells lying about at Woolwich, tried, and found to her great joy she could just squeeze herself into the fuse-hole of one of them. Accordingly, thinking she had found a capital place for her nest, she built it and hatched her eggs. But when the young were fledged, and tried to get out of the shell, they were too weak to squeeze up through the hole; and the tragedy ended by the mother bird forsaking them, and the young all dying of starvation. One would have expected instinct would have told the mother that the young birds would not have the same strength as herself, and would not have been able to do that which even she only effected with difficulty. There is also a very common instance of instinct still more clearly appearing at fault, namely, that of Jackdaws carrying sticks crosswise to their nests, and on not being able to get them in, dropping them and flying for more, instead of taking them by the end and shoving them in. In the somewhat similar case to this, of Owls carrying prey to their young, instinct does help the birds out of their difficulty; for they naturally carry their prey in their claws; but as long as the mouse, or whatever it may be, is held in their claws, they cannot avail themselves of their feet in their ascent under the tiles, and approach to their holes; so instead of dropping it on the ground like the Jackdaw, the Owl flies to a part of the roof, removes the prize from its claws to its bill, and scrambles with it to its nest.

And as a last anecdote, I will mention the following, in which, on instinct failing, reason came into action. A bird had built her nest in a vine,—which covered a wall of a building,—in such a position that, through the day, the sun shone with its full glare on to the nestlings; which were nearly being scorched by its heat. Here instinct had not prevented the mother exposing her young to death; but to prevent this fate, she came in front of the nest, in the way of the sun, and fluttering about there nearly all day, used her wings, both as a shield from the heat, and a fan to cool the young.

Of course it is exceedingly hard to know where instinct ends and reason begins. Reason is necessary to man, while instinct is sufficient for brutes, and a high instinct might be more useful than a low reason. But I think the few anecdotes out of the very many on record, which I have noticed, clearly show, that without any doubt, animals do possess a degree of reason or understanding, whichever name is preferred; and are able to calculate, profit by experience, and pre-arrange plans in a degree, though much inferior to human creatures, yet sufficient for their purpose. And now, hoping I have not been presuming in touching on the subject at all, I will end my paper.

In the ensuing conversation, the President called attention to the proper and more limited use of the word "instinctive," as only applicable to actions independent of experience, all actions founded on experience being more or less "rational."

F. R. Smith exhibited *Euplectella speciosa* (Gray), or Venus' Flower-Basket, a siliceous sponge, and read some notes thereon.

About 40 years ago during the voyage of the "Astrolabe," MM. Quoy and Gaimard, the naturalists of the expedition, received from Mr. Mercus, the Governor of the Moluccas, a specimen of a tubular sponge, which they figured in the Atlas of the voyage under the name of the "Corbeille de Venus," or *Alcyoncellum Speciosum*. Both the figure and description were very inaccurate, and the sponge was very little known or understood. This specimen of MM. Quoy and Gaimard is still in the Museum of the Jardin des Plantes, at Paris.

When the late Mr. Hugh Cumming was collecting shells in the Philippine Islands, he had a specimen given to him of the Siliceous sponge, which Professor Owen described and figured under the name of *Euplectella Aspergillum*. This specimen remained unique for many years. Mr. Cumming sold it to Mr. Broderip for £30, who on giving up his collection sold it back to Mr. Cumming for the same sum. This specimen (a very imperfect one) is now in the British Museum. A short time ago some 12 or 14 specimens were sent to London to a merchant, who hearing that the only specimen known cost £30, refused to sell any at a lower price, but the number naturally lowered their value, so that after keeping them for more than a year he sold them for £10 each, but the stock had scarcely been sold when a large importation arrived, and the price rapidly fell from £10 to £5, and from that to 30s. or £1, and now they are much less. In Manilla these *Euplectellæ* are called *Regadera*, i.e., watering-pots, by the fishermen, who get them up from deep water near the Island of Tebu.

Small crabs are often found in the tube, and the Spanish fishermen believe these crabs form the sponge for their house, but there is no doubt the crabs enter the sponge before the lid at the top is formed, which is not produced until the tube has reached its full size, and when the lid is formed the crabs are enclosed in the sponge, as in a trap. Some of these fishermen believe that a male and female crab each form a sponge, and hence they regard two tubular sponges as one specimen. Two specimens were sent to the British Museum so regarded.

Mr. Semper, who has studied these sponges at Tebu, says that two kinds of animals are found in them, a sea-louse and a shrimp ; he says he has never seen more than *one sea-louse in a specimen*, but that when he has observed the shrimp, there is *always a pair of them in the same tube* ; sometimes the single sea-louse and a pair of shrimps are found in the same sponge, and then the fishermen compare them to a married couple and a "house friend." Some persons having thought that specimens with crabs in them were more perfect and valuable, because, as they supposed, they contained the animal that formed them, the dealers have therefore sometimes broken the tubes off at the root, and inserted a crab (even English ones), and put the two parts of the sponge together again, hiding the break by the long barbed filaments at the root.

When the sponge is first formed it is only a cylindrical tube, consisting of bundles of elongated, thread-like, siliceous spicules, placed at distances from each other, and extending from the base to the top of the tube ; these are crossed by similar bundles of fibres, forming hoops at right angles with the longitudinal bundles, but leaving square apertures or meshes at certain distances. When the tube has reached its full size, a netted lid is formed over the top of the tube, and raised ridges are formed outside the tube, to add strength to the structure ; the uppermost one of these ridges forms a fringe round the top of the tube, between the lid and the tube.

The skeleton of the *Euplectella* has been compared to lace, and to the woollen knitted shawls made in Shetland. The threads of the *Euplectella* are not first spun, and then interwoven, as are works of human manufacture, but are formed by the animal as they are interwoven, the two processes of formation and weaving going on simultaneously or *pari passu*, and this is shown by the fact that in a specimen that had been broken, the hole was filled up with interwoven fibres, like a darn.

The *Euplectella*, the white object generally seen, is only the skeleton of the sponge; in its living state it is covered externally and internally with a delicate, thin, gelatinous, enveloping, organic tissue. This tissue dries on the sponge when it is taken out of the water; but specimens with this tissue are very uncommon, as collectors and dealers generally soak them in strong alkaline lees, and then in chloride of lime to bleach them, and thus this delicate tissue is destroyed.

In this tissue there is found an abundance of siliceous stars of many forms, some with simple rays and others forked, and many with divided rays looking like fingers.

When alive the sponge sucks in water at the round holes in the tube and throws it out at the mouth; this it keeps on continuously doing.

At the root, which when alive is buried partly in the sand on the bottom of the sea, there are many fibres growing, that come up towards the lid; these are barbed in different places, and the tips of many have a four-hooked grapnel-shaped barb. It has not yet been ascertained for what use these are.

This *Euplectella speciosa*, or *Euplectella Aspergillum*, is quite different from the *Alcyoncellum speciosum* of MM. Quoy and Gaimard.

54 were present.

At a Private Business Meeting, the number of the Society was limited to 20 Associates and 20 Members.

MEETING HELD JUNE 6TH, 1868.

THE following Exhibitions were made:—Rock Salt from Marsden, Cheshire; by F. R. SMITH. Rock Salt from Germany; by S. HARRIS. Partial Umbel of *Chervil*, becoming compound; by the President. *Pholydophorus*, Fish Remains, and *Lingula*, from the fish bed at Newbold; by E. CLEMINSHAW. Swift's Nest and Eggs; by N. MASTERMAN. Bones of Saurians, from King's Newnham; by J. ARMITAGE.

F. R. SMITH then read a Paper "On the Salt Works in Cheshire," which he had visited during the Easter holidays. The Paper was divided into two parts; one describing a visit to Messrs. Worthington and Co.'s Works at Northwich, where salt is manufactured from brine; and the other a visit to Messrs. Johnston and Co.'s Rock Salt Mines, near the same place.

The President then read a Paper "On Dimorphism;" from which we extract the following:—

A FEW words may not be wasted on *Dimorphism* in Plants. Considerable attention has of late years been spent on this subject, and discoveries are still being made. If we cannot make any discoveries for ourselves—though it is not impossible that we should do so,—we ought, at any rate, to know the new discoveries as they arise.

Dimorphism or *Trimorphism* means the existence of two or three distinct kinds of individual in a plant or an animal. This is quite distinct from *variability*,—that is, the tendency of plants of the same kind to vary within certain limits. It means the existence of distinct forms, as the queen bee, the working bee, and the drone ; or again, the pistillate and staminate willows ; or again, the winged and wingless ants. The females of certain butterflies have appeared of several distinct forms, not connected by any intermediate varieties. "Certain Brazilian crustaceans," says Müller (quoted by Darwin), "have two forms of males,—one provided with pincers, for seizing ; the other with smelling-hairs, by which the sense of smell is made to make up for its want of pincers." The point is that in animals it is not unknown to find not only male and female, but more than one kind of male, or more than one kind of female. I do not know the details of these cases ; and I pass on to what is more within our reach, viz., the cases of Dimorphism in Plants.

The plant in which we can most easily observe Dimorphism is the Primrose, or Cowslip. In these plants, if a number of flowers be gathered, they consist, in about equal numbers, of two forms,—you can easily see that one form has the pistil protruding beyond the stamens, and the other the stamens beyond the pistil.

These are produced about equally. I counted this summer a large basket full, of several hundreds, and the kinds did not differ in number by more than 10 or 15. The same root and stock *always* bear the same form ; hence you must not be surprised in a bouquet containing some primroses to find them all the same, as they have perhaps all come from the same plant.

The differences are shortly these :—Long-styled form has long style ; globular stigma ; rough stigma ; short stamens ; smaller, oblong pollen ; upper half of tube expanded ; number of seeds smaller. Short-styled form has short style ; flat stigma ; smooth stigma ; long stamens ; longer, spherical pollen ; tube of corolla uniform in breadth till near the end ; number of seeds larger.

The President then detailed the differences of the two forms, and exhibited specimens of each. For details, the reader is referrrd to an article by Mr. Darwin, *Linnean Society's Journal*, vol. vi., p. 77 (in the Society's Library). A good popular description is given in the *Popular Science Review* for 1868.

The number of seeds in a capsule is found to be affected by the question, whether the plant has been fertilized by pollen from itself or from one of its own form, or from one of the other form. Those fertilized with their own pollen are found to be distinctly less fertile than those fertilized with pollen from the other form of plant. For the details of Mr. Darwin's, see the paper quoted above.

Another plant which Botanists can and should examine is the *Lythrum Salicaria*, or Purple Loose-strife, which you can get at Swift's. This plant is trimorphous. *i. e.*, it has three forms growing on different plants. These forms were first discovered by a Frenchman in 1841. Each plant has one pistil, and two whorls of six stamens each, but the whorls have their filaments of different lengths. One plant has longest style, middle and shortest stamens ; another has middle style, longest and shortest stamens ; and the third, shortest style, and longest and middle stamens. The account of the different degrees of fertility produced by different crosses of these forms is given in *Linnean*

Society's Journal, No. 31, p. 169. Similar cases have been found in Flaxes (*Linum*), in Oxalis, in Mints (*Mentha*), in Polygonums, and in plants of the *Rubiaceæ*, *Boragineæ*, and *Orchidaceæ*. The number of cases is daily being increased, and by studying known cases, you may possibly be led to discover others, which have not as yet been noticed.

The President then referred to the deductions drawn from these plants by Mr. Darwin in a paper read February, 1868 (*Linnean Society's Journal*, No. 47, p. 393).

The two points which young Botanists may note are,—(1) that these forms bridge over the apparently extreme difference between *diœcious* plants like the willows, and ordinary *perfect* plants. (2) that the use to the plant seems to lie in the greater fertility produced by crossing. Compare the advantage gained by the ray florets of a daisy, in being necessarily fertilized by the inner florets.

I hope you will find some specimens of Dimorphism, and *exhibit them* at our next Meeting.

46 persons were present.

MEETING HELD JUNE 27TH, 1868.

Exhibitions:—Pod of Cingalese Cotton Plant, and Cast of same; by A. F. NORTHCOTE. *Lythrum Salicaria*, exhibiting trimorphism (longest and shortest pistil); by E. CLEMINSHAW. *Diplograpsus pristis;* by Rev. C. ELSEE.

The Rev. T. N. HUTCHINSON then gave an address "On Axes of Rotation," and after exhibiting a variety of experiments, concluded with "The Gyroscope."

28 persons were present.

MEETING HELD JULY 4TH, 1868.

Exhibitions:—Reed Warbler's Nest; by N. MASTERMAN. *Echium vulgare* (var.), and *Reseda lateola*, plants new to the list; by F. R. SMITH. *Cuscuta Epithymum* (alive), from Devonshire; and two coherent cherries, with a common peduncle; by the President. Pearl from *Unio margaritifera* (Fresh-water Muscle); by J. D. LAWE.

A Paper was read by E. CLEMINSHAW, "On the River Gravels." At a subsequent Meeting, Mr. WILSON expressed his dissent from some conclusions in this paper, and his views will be found subjoined.

IN the neighbourhood of Rugby we have two distinct formations. The Lias and the Limestone which form the fundamental rock of the district extending to Newnham Regis, and is succeeded by the New Red Sandstone; and secondly, the gravel deposit, which I wish to say a few words about. It is scattered very irregularly over the face of the country: in some places it is very thick, while in others it thins out to a mere strip. When we come to examine it we find that it is of two kinds. In the first place we find in the valleys, and on the slopes of the rising ground, beds of sand and gravel, which have evidently been deposited under the influence of the River Avon; secondly, gravel which has been deposited under the influence of glacial action. I do not mean to bring forward here all the arguments in favour of the Glacial Theory, but you must take for granted that there was a Glacial period; and we will notice its effects in this neighbourhood as far as is possible in the present state of our knowledge. Firstly, then, all over the higher grounds we find a confused deposit of gravel, chiefly composed of chalk, flints, and oolite pebbles, and in many of them we find the fossils peculiar to those formations: we also find pebbles of quartz and slate rock, and now and then pieces of syenite—a species of granite rock. This is the general character of the stones in the gravel in the south and immediate neighbourhood of Rugby. If we go more to the northwards, at Newbold and Hungerfield, we find the gravel there has a different character. We find blocks of Millstone Grit—a hard siliceous grit-stone, of Carboniferous Limestone, and other specimens which look as if they came originally from rocks which are found in the North of England. But what is there to found a supposition on that this gravel has been deposited by glacial action? It is this: we find that several of these stones and blocks are ground down on one side, and marked with parallel striations. What could have made these markings? Nothing but immense masses of ice which ground down the rocks as they slowly moved down over them, and made these strive on them by the stones which had got frozen into the mass. Very often these rocks would get broken, and the fragments carried away in the ice. Now in Arctic regions, as in Greenland, the glaciers and land-ice reaches down into the sea, and as it is continually being pushed forward, it breaks off at the end, and large blocks—bergs and fields of ice, go floating off down the Coast of North America, and they carry with them any rocks, stones, or rubbish the ice may have collected in its passage over the rocks: when the iceberg fell to pieces or melted, these stones and rocks, which would have been scratched by the passage of the ice over them when they formed part of the land, would be deposited in masses over the bottom of the sea. Now this is the way in which these glacial gravels have been deposited. The greater part of Great Britain was under water—the mountains and hilly country only being above water, and this was covered with ice. The proof of this partial submergence of Great Britain is afforded by the occurrence of shells in the gravels, which occur in different places in Scotland and Wales at a considerable elevation above the sea. These shells are only found now in the Arctic Ocean: thus they show that England was for the most part covered with water or an Arctic Ocean during the Glacial Period. From observations in Scotland, it is found that there were two or three oscillations of level during this Period. These gravels, then, were formed by the rubbish, stones, etc., deposited on the bed of the ocean by floating masses of ice, some of the stones shewing marks of the travel of the ice over land.

Where did these stones come from? This cannot be answered directly in the case of these gravels, as it can be in the case of certain boulders which are found scattered over different parts of Great Britain. There are, however, two distinct kinds of gravel here—the gravel found at the south and immediate neighbourhood of Rugby, containing chalk, flints, and oolite stones, which probably came from the South, or from the Chalk Downs, the oolite stones being brought here by the bergs scraping along the bottom of the sea. The origin of the other kind of gravel, which we meet with at Newbold and Hungerfield, seems to be in the North; there are masses of Carboniferous Limestone, Millstone Grit, etc., such as are met with in Derbyshire and Yorkshire, while several of the specimens in the Arnold Library, from Hungerfield, Mr. Etheridge said, probably came from Yorkshire. We, however, find also some specimens of the other kind of drift at Hungerfield, and we find there two kinds somewhat mixed. We may thus infer that there were two streams of bergs—one a Northern, and another a Southern, and that they met somewhere about here, and thus we find their general deposits somewhat mixed. It is not at all easy to be certain about the origin of a good many of the gravel deposits in this neighbourhood, but we cannot be far wrong if we assign the gravels which are not well stratified, and which occur on the high ground, as belonging to the Glacial Period. I might mention the very good illustration of glacial deposits there is in a deep cutting on the Midland Railway at Leire, a little beyond Ullesthorpe: it contains several very marked boulders, some of them of large size and well polished.

I will now say a few words about the river gravels, which are of a more recent period. After the deposition of the glacial gravel the rivers began to do their work, and gradually to cut out their valleys. I do not mean to say that all valleys have been formed by the action of the river which runs through them; but a small valley like that of our Avon most unquestionably has been so formed. We can well see the marks of it in the various steep declivities which have been formed whenever the river gives a considerable turn—such a declivity as that at Newbold, or Caldecott's Spinney; indeed they may be traced all along the river's course. Now, at first, the river would be at a much higher level than it is now, and would wear down and rearrange the glacial gravels, depositing them in a stratified form, as sand and gravel banks, along its course, and burying any bones or shells in it. We have, to all appearance, many of these gravels in this neighbourhood; the ballast pits at Lower Hillmorton are of this formation, the pits on the footpath to Newbold, traces of it are to be seen on the Lawford Road, and many of these gravels at this level seem to be of this origin. I say seem, for as, as yet we have found no shells or bones in them, it is difficult to be certain about their age. Still from their level, from their stratification, and from the sand mixed up with it, and the absence of all scratched stones or stones of any very great size, we may probably put them down as river gravels. Along the valley of the Severn and Avon many series of river gravels have been noticed, at some height above the river and at some distance from it. They probably correspond to the gravels I have just mentioned. From their level above the existing river they are generally called high level gravels. The only two places at which animal remains have been discovered in the older gravels are at the old workings near Lawford Mill and at Newnham Regis. About fifty years ago the discovery was made at Lawford of the bones of the Mammoth, Rhinoceros, and of the first Hyena found in England: these were found about 18 ft. below the surface in river mud, which contained the remains of river shells in plenty. The animals had probably been washed down by some flood and the remains deposited in this hole. The other discovery was at Newnham Regis. When some old fishponds, which are at some height above the river, were being cleaned out several bones were found: I think they belonged to the Mammoth.

The lower river deposits, in which so many bones have been found lately, belong to a much later period. When the river had worked out its present valley, it deposited at the bottom and along the banks a mass of sand, gravel, and mud, filled with various river shells: into this mud was washed the bones of various land animals, probably carried there by the floods. We find this later deposit all along the river valley, and running into the smaller valleys, as at Newton and other places. These bones comprise bones of the *Equus fossilis*, *Bos primigenius*, and deer. I also found near Newnham, close to the river, the tooth of a bison or Auroch, which is, I believe, all but extinct in Europe. Man was also contemporary with the animals. I have found three undoubted flint weapons, two near Newbold and one near Newton. The river is now doing very little work, merely cutting its way through this latter deposit of mud and gravel. This is merely a slight sketch of the gravels of this neighbourhood: discoveries in it have been made slowly; but any time a valuable discovery of bones may be made by some fortunate geologist. And I would strongly urge any geologist by no means to neglect these gravels. If any new gravel pit is opened by all means go and see it. A new pit was opened near Newnham lately: the gravel was four feet thick, and at the bottom was a deposit of dry earth resting upon Lias clay. At some future time perhaps some discovery may be made which will better solve the question of these glacial gravels, for it is by no means certain what is the origin of a good many of them. We must not come to conclusions so soon about them, but work them up, and probably some future discovery will throw a better light upon them.

NOTE BY MR. WILSON.

I HAD the misfortune to be absent when this paper was read, and I have, therefore, no means but the present of expressing my dissent from many of the statements of facts, and most of the conclusions. The paper is interesting to me as stating, in the form of proved conclusions, what were floating about in my mind in the year 1867, and often mentioned by me as possible hypotheses on which to observe. But I am very unwilling that it should be published as in any way final, or as having received the sanction of the Society.

I do not recognize the description of the gravels (in line 14) as applicable to any locality in this neighbourhood. There is a wide-spread deposit of gravel and sand over much of this county, consisting of flint and quartzose pebbles, mixed in various proportions. I have seen no proof of this being glacial; I have seen no scratched stones from it, no arctic shell, no erratic block. The piece of syenite referred to is, perhaps, one I found in the ballast pits at Hillmorton, but I never affirmed it to have been found *in situ*, and igneous and metamorphic rocks are excessively rare in it. I have never seen chalk in it, and *very rarely* a doubtful fragment of oolite.

There are deposits here which are probably glacial, but then they are not sands or gravels, but reformations of clay and marls; and these imbed striated stones of various age from Palæozoic to Eocène, among which chalk is the most abundant. These are local, but widely dispersed, and distinguishable by the most cursory observation from the Lias clay, and from the gravels and sands. The Hungerfield deposit is one of these, and was discovered by Messrs. Taylor and Alexander; but the others which lie in the immediate neighbourhood are not noticed.

I do not see any reason for assenting to the suggested "way in which the high level glacial gravels were deposited." "The two drifts are somewhat mixed in this neighbourhood." In a paper by Strickland some remarks are made on the flinty drift and the quartzose drift, and it is, I believe, there pointed out, and I have often repeated the remark, that these two drifts seem to mingle about Rugby. The remark is wholly inapplicable to the glacial clays and sands (not gravels) of Newbold and Hungerfield. I am compelled to wonder whether the writer of this paper ever saw the glacial deposits at either of these places.

The origin of the Avon valley needs the "*adulta suspensio judicii*," and can scarcely be disposed of by an "unquestionably." The remarks about the "high level gravels" seem to me to be without foundation. The sand pits at Hillmorton and on the footpath to Newbold were taken for the possible equivalent of high level river gravels by amateurs who visited Rugby in 1867; but there is not a shadow of proof, nor, as it seems to me, of verisimilitude for the view. The texture of the sand, the nature of its contents, and above all its position as underlying the general flinty stratified drift at Hillmorton and Clifton, seem to me to indicate a marine origin to the sands. They cannot be called "gravels" with any propriety. And they seem inseparably connected with undoubted glacial deposits.

I am still more astonished to read that the high level gravels at Lawford exist or have yielded fossils. It is well known that a local deposit did so, but by its position it would belong rather to the equivalent of the low level gravels. But it is extremely doubtful whether high level or low level gravels exist here, in the sense, at least, in which they are used lower down the Avon.* Our alluvial meadows are very rarely and doubtfully fringed by terraces, and the gravels that form the slopes can be barely distinguished, if at all, from the general drift. I, at least, am unable to distinguish them, and they are very rarely visible.

I must further enquire on what authority the bones found in the alluvium are referred to *Equus fossilis*, *Bos primigenius* and *Bison priscus*. I shewed many of these bones and teeth to Mr. Etheridge, who professed himself unwilling to name them, and hazarded a suggestion that one of the teeth might be that of a Bison *priscus*. Is it on this authority they are named? if not on whose?

There are flints, it is true, in the alluvium. But in reasoning about them it must be remembered that in precisely similar alluvium at Newton, associated with Anodon and bones of horse and ox, were found by Mahony and myself pieces of pottery, bottle glass, and part of a tobacco pipe, which are now in my possession.

I hope these criticisms will not be thought unnecessary. It would be easy to add to it. It is our duty not to put a bar on further investigation by closing theories which are really open; and I cannot but express my views that in this paper Mr. Cleminshaw has neither given the Society much original or accurate observation, nor combined it so as to establish theoretical views with proper scientific caution. He will allow me to add that it is because he is the best geologist the School has produced during ten years, as a collector of species, and has obtained a corresponding reputation, that I cannot let his assertions pass without recording my dissent from them.

This was the last Meeting of the Summer Term, and 33 persons were present.

Meeting held September 26th, 1868.

J. D. Lawe was elected to hold the Geological, and N. Masterman the Zoological, Album.

Exhibitions:—*Cuscuta Europœa* (Switzerland); by the President. Seed of Passion Flower; and Human Bones from a cliff at Dunwich, Suffolk; by H. Wilmer. Fossil Bivalves from Coal, Chorley, Lancashire; by A. Napier. Skin of the Grass Snake; by N. Masterman. Binoxide of Manganese, in dendritic delineations, from Penmaenmawr; by T. D. Ralli. A Double Fish, from the Gulf of Mexico; by J. Byrne.

---

* I am informed by T. G. B. Lloyd, Esq., F.G.S., that the gravels of the Lower Avon are marked by physical features and peculiarities, which, as far as my observation goes, are not reproduced in this neighbourhood.

J. H. Davies then exhibited *Cuscuta Hassiaca*, a plant which has recently re-appeared in Herefordshire; and read some notes on its discovery, of which a summary is given :—

The *Cuscuta Hassiaca* was discovered by the Rev. J. F. Crouch, on the 27th of July. 1868,—his attention being drawn to it by W. Langston, Esq., M.R.C.S., in whose field at Marston, in the parish of Pembridge, Herefordshire, it was growing plentifully on Lucern. It is among the species excluded from the *London Catalogue of British Plants*. It was found, by Mr. Varenne, near Witham, Essex, in 1851, and also previously, near Riven Hall, in the same county. It is not known to have occurred since that time until the discovery here recorded. The Lucern on which it grew was raised from seed purchased from a London firm, and probably foreign.

Its chief marks of distinction from the other *Cuscutas* are :—

i. Its flowering in racemes, each flower having its own stalk.
ii. Its broad, fimbriated scales.
iii. Its round stigmas.
iv. Its transparent calyx, sitting close upon the corolla.
v. Its elongated, campanulate flower, which gives it great elegance.

It is parasitical on Lucern, Yellow Bedstraw, Wild Camomile, Sow-Thistle, &c. It is a very elegant species, with a scent rather resembling that of the Heliotrope.

Mr. Hutchinson exhibited specimens of *Hippocampus brevirostris*, and made remarks thereon.

There were present 28 persons.

Meeting held October 10th, 1868.

Exhibitions :—Glacial markings on Carboniferous Limestone, from Castle Town, Isle of Man, cut from under boulder clay; by Mr. Wilson. Cedar of Lebanon Cone; by H. W. Sandars. *Viscum album* from an apple tree, the first recorded at Rugby; by the President.

Acidalia rubineata, *Agrophila sulphuralis*, *Heliotis dipsacea*, were presented by the Rev. A. H. Wratislaw.

The President showed some perfect flowers on *Lychnis dioica alba*, found at Rugby, and made some observations on the occurrence of perfect forms in diœcious plants.

Among some Lychnis Vespertina (*Dioica alba*) found behind the Roman Catholic Chapel, was one plant having perfect flowers. These flowers I unfortunately did not discover to be perfect till most of them had been destroyed. One I preserved had distinctly mature pistil and androecium.

This, though rare, is not unknown. Smith and Sowerby, and Babington state the flower to be diœcious; Bentham says "generally diœcious;" and Hooker says "In both *L. dioica (rubra* and *alba)* the flowers have occasionally both stamens and pistils, but we have seen none such in which one or other are not abortive."

This plant is worth recording, inasmuch as the separation of pistils and stamens (diœciousness of plants) has had new light thrown on it by Mr.

Darwin. Mr. Darwin considers that a larger quantity of seeds are produced by crossing the pollen from one plant to another; that hence the advantage derived by dimorphous plants. These Mr. Darwin considers a step towards complete dioeciousness.

The plants I have found I suppose to be a case of atavism, or reversion.

NOTE.—The exact distribution of Lychnis dioica rubra and alba at Rugby seems worth careful notice, the Red and White species not being found much together, as if there were a sort of struggle for existence going on. F. R. Smith has a curious specimen of a hybrid between the two.

N. **MASTERMAN** exhibited Drawings of the new Japanese Silk-worm, and some account of these Silk-worms was read.

37 persons were present.

AT a Meeting for Private Business, a rule for the admission of Corresponding Members was passed.

MEETING HELD OCTOBER 24TH, 1868.

Exhibitions.—Pipe Madrepore, from Whitby; by J. D. **LAWE**. Farthing of George I., found at the building of the New Schools, Rugby; by the President. Slate with crystals of alum from North Wales; and stone bored by *Pholas*; by R. **DUFF**. Block of Dolamite from the Laxey Mines, Isle of Man; by Rev. T. N. **HUTCHINSON**. *Ostrea* (new species), and Fish Remains from Newbold; by J. **ARMITAGE**. *Cyathus Hiatus*, one of the Nidularia tribe of Fungi, from Herefordshire, was exhibited and commented on by J. H. **DAVIES**.

Mr. **KITCHENER** read the following paper "On Bud Variation."

I READ lately in a Scientific Magazine a review of the publications of several local Field Clubs and Societies like our own. The Editor praised the apparent activity displayed by several of these Societies, but complained that despite the number of its members, and their apparent zeal, there was little evidence that any of them were keeping their eyes open in the search for evidence which might bear on the great question of the day, the Origin of Species; and the writer might have added the great question of every day, the development of individual life.

I am anxious that (as far as possible) our Society should have its chance of observing such facts as are becoming of importance in this question of questions, how New Species are produced. The question baldly put is this. Is there evidence to think that species, once existing, are immutable; or do we find evidence to lead us to suppose that New Species are gradually developed out of old ones?

The principal difficulty on the side of those who plead for a gradual development is this—if any advantageous type arises, if for instance a race of rabbits exist, which by their colour have an advantage over their neighbours, we can see that they will have a chance of out-living them, till what is at first the exception in colouring becomes the rule—but what induces the first rabbit to be of the required colour?*

---

*Mr. Sidgwick, in a paper read to the Society last year,—and which Dr. Hooker, of Kew, considered the most suggestive in the book—called attention to the way in which the colours of a Species or Variety could be advantageous, The process by which an exceptional Variety may be turned into a fixed Species is called Selection by the Survival of the Fittest. But what is the cause of *Variation?* This is the difficulty: could we once give the laws of Variation, I have little doubt that Selection would be more generally accepted. Now while the laws of Variation are obscure, and little known, almost any observation of a Variation *may* be of immense value—and is *sure* to be of some.

A vast number of stray observations on this subject have been collected in a great book, the two first volumes of which are now out—Mr. Darwin's Book on Variation. This book is extremely good in many ways, but not its least merit is the admirable clearness, and methodical order in which a set of heterogeneous observations have been arranged so as to make them bear on the question at issue. Facts are there gleaned from all quarters, newspapers, published papers, private letters; facts relating to mankind, to animals, to plants: and it must be a considerable stimulus to the young observer to see how trivial observations, once recorded, have, after the lapse of years, been made to throw light on important questions.

My object to-night is to introduce to you a class of observations which I think will be new to many of you, and which may be afterwards followed up by Members of the Botanical Section.

Plants are not only propagated by seed, but also by buds. The methods by which this is done are called by gardeners—slipping, grafting, layering. In slipping—a small portion of a branch is cut off, care being taken to select one which has a bud in it; the end of the branch is then put in earth, where, if kept sufficiently hot, supernumerary roots are produced, by which the bud is fed, till it developes into a complete plant.

In layering—the process is similar, with this difference: the branch is severed from the mother plant after, and not before, the roots have begun to grow.

Grafting is distinctly different. The object in this case is to transfer a bud of one tree on to an old stock, where it may grow and be nourished by the roots of the tree on which it has been grafted.

In *cleft-grafting* the trunk of a tree is cut through horizontally, and a vertical cleft is made in its centre some inches deep. Into this cleft the branch of a graft with several buds, and cut to the shape of the cleft, is inserted, which is closely in contact with the sides of the cleft. The cleft is then covered with mortar of some kind, and bound firmly together by means of cord.

We have again cases in which plants may grow by *section*, as by slices of potatoe, each slice being obliged to contain an eye, or undeveloped bud. In all these processes the essential part is that each portion separated from the parent plant may contain a bud; an undeveloped branch; a plant in little. The young buds separated from the mother plant live by themselves. Does this not lead to a new idea as to the character of buds, by which a plant is considered analagous to a compound zoophite? What is that but a tree with living buds, each having a separate vitality? And in plant life we have even an analogy to the spontaneous separation of the zoophite, for in some few plants buds separate from the parent plant spontaneously, and form independent plants. Such are the viviporous forms of some grasses (particularly found among *Festuca* and *Poa* on mountains)* and the small bulbs of onions.

---

* These grasses grow above the height at which they can produce seed. I have gathered them on Helvellyn,

Nor, again, to complete the analogy, are the processes of slipping and grafting without their analogies in zoophitic life.

You must know that many of the lower animals can be multiplied by cutting them in pieces. A worm cut into forty pieces will produce forty worms.

Again, the transference of a living piece of flesh, although not a complete organism, like a bud, has been effected without loss of life. Mr. Darwin quotes a case in which "the spur of a cock, after being inserted into the eye of an ox, lived for eight years, and acquired a weight of 306 granules," or nearly fourteen ounces. The tail of a pig has been grafted into the middle of its back and reacquired sensibility. A piece of periosteum from the bone of a young dog has been inserted under the skin of a rabbit, and the bone has been developed.

I have mentioned this analogy in order to give you more ideas as to what a bud is.

It is about the variation of these buds or young plants that I wish to speak.

"Variation!" you will say; "but how can a bud vary? What reason is there that a bud should vary? Do you mean to say that if I make a cutting of a geranium I shall not get the same geranium again? Do not slips come true?" Undoubtedly they do come true as a general rule, but I have exceptions to set before you, and these exceptions are the doors by which new varieties creep in.

Now, I ask why do we expect plants to come more truly by bud than by seed? One reason, of course, is that seeds are often produced by the pistil of one plant being fertilized or crossed by the pollen of another. If the two plants happen not to be the same, in however small degree, an element of variability is introduced, and the resultant seed is, to some degree, a hybrid. Many people's only idea of variation—whether in animals, as in sheep or pigeons; or in plants, as in geraniums—is that produced by crosses. But this is a very limited view of variability. Let me give you a few instances.

There is a mode of variation well known as reversion. That is, a plant or animal is found to go back to the appearance of some remote ancestor: thus pigeons show traces of the old rock-pigeon; and horses occasionally show the stripes of the zebra, their supposed ancestor. Now this reversion in plants often affects only *parts* of a plant, and not its whole: thus a part of a variegated oak may go back to its plain leaves. Such a branch was exhibited by Mr. Wilson last year.

Again, we have the reversion in toad-flaxes to a primitive regular type, as in the flowers I now exhibit.

I also exhibit some variegated oak, and fern-leaved beech, recurring to the primitive form.

In the case of some hybrids we have many curious examples of bud reversion to either one, or both the parent forms. I will take a well-known one from Mr. Darwin's book—the *Cytisus Adami*, or Adam's Laburnum. It is called by him "one of the most curious cases of reversion to *two* parent forms on record." Its proper colour is a dingy red, and it is a hybrid between two distinct species, viz.: the common yellow, and the purple laburnum. The flowers of the hybrid are dusky red, but on the same tree there have frequently been found branches differing both in their leaves and manner of growth, one having yellow, the other purple flowers, while the rest of the tree is bearing its ordinary dusky red ones. On the same branch both purple and yellow flowers have been seen; and what has the oddest effect of all, the same *flower* has sometimes been affected, so that one half of it was purple, and the other yellow. A red flower has been observed with a yellow streak in it, and a stamen slightly monstrous, was partly purple, and partly yellow.

The *Cytisus Adami* in its intermediate or red state is always sterile, but bears good seed in those flowers which have reverted to either of their parent forms, and have become yellow, or purple. The number of seeds which they produce seems in proportion to the thoroughness of their reversion, for Mr. Darwin states that from a yellow branch *exactly* resembling the common laburnum, he obtained pods containing a plentiful supply of fertile seed; from a purple branch, which differed slightly from *Cytisus purpureus* in its growth, he got a very scanty supply. Many pods were empty, some had one, none more than two seeds; while in the pods of a pure *Cytisus purpureus* he found three, four, and five seeds. The plants raised from the seeds of the yellow branch were *generally* pure common laburnum, though in a few there was a tinge of purple. Those from the seeds of the purple branch closely resembled *Cytisus purpureus*. All the plants bore perfectly good seeds.

Various theories have been started to account for the origin of *Cytisus Adami*. Some authors consider it a case of simple bud variation. This view is supported by no evidence, and would require much to make it tenable. Others think of it as a simple case of reversion of a hybrid to the two parent forms. Others again believe that two embryos might have been contained in one seed, and that they adhered: in this case, the tendency to reversion would of course be very strong. The case most like this is recorded by Mr. Thwaites. He tells of a seed from *Fuchsia Coccinea* fertilized by *Fuchsia fulgeus*, which contained two embryos, both green, and produced plants differing widely. They were "closely adherent, below the cotyledon leaves, into a cylindrical stem, so that they had the appearance of different branches growing on one trunk." Unfortunately they died before flowering.

Many authors believe *Cytisus Adami* to be produced in the usual way by seed; but Mr. Darwin and other Botanists have vainly tried to cross *Cytisus purpureus* and Common Laburnum.

M. Adam's own account is that he grafted in the ordinary manner a shield of the bark of *Cytisus purpureus* into the Common Laburnum. Two fine branches appeared, which he sold as *Cytisus purpureus*. It afterwards was found that they bore red flowers of a dusky hue. If this explanation be true, *Cytisus Adami* is not a seed, but a graft hybrid.

The only specimen resembling this which I can show you are branches from an (I believe) hybrid *Robinia*, bearing both pinnate and bi-pinnate leaves, and some leaves partly pinnate and partly bi-pinnate.

Besides reversion, however, we have many cases of bud variation in which new forms have sprung up. Among plants exposed to natural conditions bud variation is less common, but I may exhibit here some blue and yellow specimens of *Viola lutea*, which I gathered from the same plant near Grindelwald. This plant is most variable under the slightest cultivation, in fact you can tell, as you descend a valley, each stage which the soil makes in productiveness by the increasing size and the increasing blueness of *Viola lutea*. Still I was a little astonished to find such distinct forms on the same stem. I find, however, that the like had been noticed by Professor Caspay. (Darwin, vol. i, page 408.)

More notorious cases of sudden variation are the Moss-rose and Nectarine. I have not time to give you here the details.

The Nectarine is supposed to have grown spontaneously on the peach. The Peach itself may possibly be a modified Almond; it was introduced into England, from Persia, in 1562. But, however this may be, it is well authenticated that not only have Peach *stones* produced Nectarines, and Nectarine stones Peaches, but that the same tree has borne Peaches and Nectarines. Peach trees suddenly produce Nectarines, and also fruits half Peach and half Nectarine.

In many of these cases the possibility of a cross is excluded by the absence of the Nectarine—and, moreover, where did the original Nectarine come from? Again, the Moss-rose is supposed to have arisen by bud variation from the Provence-rose, for branches of the Moss-rose have produced Provence-roses, wholly or partially destitute of moss. It was introduced into England, from Italy, in 1735. This origin of the Moss-rose is confirmed by the fact that a variety of the Provence-rose, the *rose de Meaux*, has given rise to a sporting branch, the *Moss rose de Meaux*. The variations, when produced, are generally capable of being continued by *cuttings*, though they are often lost by *seed*. It is noticed, however, that in some plants the buds on the cuttings themselves do not revert, while buds developed from the roots by suckers, or otherwise, do revert; so it is with trees with variegated leaves. For instance, in the *Gardener's Magazine* for September, 1866, I read the following concerning the Pollock Geranium:—"Having seen several questions in the *Gardener's Magazine* with regard to Mrs. Pollock being a seedling, I have one thing to remark. Two years ago, being anxious to increase the stock, I shook out several large plants, and cut up the shortest *roots*, and struck them in the ordinary way; but, to my surprise, not one came variegated. They made very good plants for turning out, but I have not seen the slightest tendency in them to return to the variegated character again. I may further remark that, amongst the thousands I have struck from cuttings, I only remember one instance in which it ran to green. I should like to know if any of your correspondents have tried the silver-edged kinds from roots, and if they came true."

We have here a wide field for observations: stray facts may, as I said before, be of value; for the further details of the subject I will refer you to Mr. Darwin. I may also say that Mr. Darwin has suggested an hypothesis to account for these, and many other kindred facts—which he calls "Palingenesis." This theory is confessedly an hypothesis, but it is very suggestive, and will have to be tested as the theory of gravitation, and the undulatory theory, has been, viz., whether it will or will not account for facts hereafter to be discovered. It is quite possible for a false hypothesis to explain all known facts; it is the test of a real one if it shall hereafter be found to explain new ones as they arise. Hence the call for observers in the field of enquiry.

I may here say that I have spoken only of bud-variation, because it is less known. The variations of seed are of course more wonderful, and more extensive: they too offer an almost appallingly complicated problem to the Naturalist.

MEETING HELD NOVEMBER 7TH, 1868.

Exhibitions:—Monstrosity of Pear; by the President. *Papilio Machaon*, from Wicken Fens, Cambs., caught by F. S. GWATKIN, exhibited by N. MASTERMAN.

D. A. OGILVIE then read a paper on "Caterpillars."

Some extracts were read from a letter of N. LARDEN (O.R.), describing the Fauna of the Argentine Republic.

J. D. LAWE then read a paper "on Rats."

The **President** read some notes on some special movements, aiding the fertilization of the Gladiolus.

In all 34 were present.

MEETING HELD NOVEMBER 21ST, 1868.

Exhibition:—Coal made up by the spores of a Gymnogram, from Wenlock, Salop; by F. R. **Smith**.

Dr. Farquharson read a paper "On the Mechanism of Sound and Voice in the Animal Kingdom." This paper was ably illustrated by diagrams, painted specially for the meeting by J. **Farquharson**, Esq. Without these diagrams we despair of the subject being intelligible to our readers, and are therefore obliged to omit Dr. **Farquharson's** paper.

There were 40 persons present.

MEETING HELD DECEMBER 5TH, 1868, IN THE NATURAL SCIENCE SCHOOL.

Mr. Wilson sent the following record of the Heights near Rugby, extracted from the Ordnance Survey, and communicated by Sir **Henry James**, Director of the Survey.

LIST OF ALTITUDES OF BENCH MARKS IN THE NEIGHBOURHOOD OF RUGBY ABOVE THE MEAN LEVEL OF THE SEA AT LIVERPOOL.

ROAD FROM COVENTRY TO DAVENTRY.

	Feet.
Mark on the eighth Mile-stone from Coventry, and 82nd from London, 1·57 ft. above centre of road	370·207
Mark on the 9th Mile-stone from Coventry, and 81st from London, 1·50 ft. above centre of road	375·588
Mark on the 10th Mile-stone from Coventry, and 80th from London, 1·67 ft. above surface	392·736
Bolt in West face of tower at North side of door of Dunchurch Parish Church, 2·60 ft. above surface	403·518
Mark on the 79th Mile-stone from London, and half a mile from Dunchurch, 1·53 ft. above surface	330·753
Mark on the 78th Mile-stone from London, and 1½ from Dunchurch, 1·67 ft. above centre of road	288·387
Mark on the 77th Mile-stone from London, and 2½ from Dunchurch, 1·09 ft. above surface	297·900

ROAD FROM DUNCHURCH TO RUGBY.

Bolt in corner of stable at West end of the Cock Robin Inn, 2·55 ft. above surface	400·598
Bolt in angle of Bilton Field Toll-house, Rugby Road, 1·86 ft. above surface	391·839
Mark on the 1st Mile-stone from Rugby, 1·26 ft. above surface	382·276
Bolt in front of Rugby Church tower, 1·01 ft. above surface	378·345

ROAD FROM PAILTON TO RUGBY.

	Feet.
Mark on North-west angle of Pailton Toll-house, 1·82 ft. above surface	424·030
Bolt in West face of tower of Harborough Magna Church, 4·49 ft. above surface	391·660
Bolt in North-east angle of tower of Newbold-upon-Avon Church, 2·50 ft. above surface	322·091
Mark on South-east angle of Newbold Toll-house, 1·53 ft. above surface	274·593
Bolt in corner of Brownsover Mill, 1·49 ft. above surface	286·705

ROAD FROM BROWNSOVER MILL TO HILLMORTON.

Mark on stone course at West side of bridge No. 66 over Oxford Canal, Clifton Road, 9·16 ft. below top of battlement	311·023
Mark on South battlement of bridge over the North-Western Railway, Clifton Road, 1·54 ft. above surface	355·737
Bolt in corner of stables at junction of roads to Hillmorton, Clifton, and Rugby, 2·00 ft. above surface	386·628
Mark on North-east corner of Rugby Union Workhouse, 1·02 ft. above surface	385·352
Bolt in South face of tower of Hillmorton Church, 4·04 ft. above general surface	321·288

ROAD FROM HILLMORTON TO DUNCHURCH.

Mark on the 84th Mile-stone from London and 3rd from Dunchurch, 1·00 ft. above surface	403·459
Mark on the 85th Mile-stone from London, and 2nd from Dunchurch, 1·40 ft. above surface	400·063

HILLMORTON ROAD.

Mark on North end of barn at South side of Hillmorton Road, 2·61 ft. above surface	383·260
Bolt in North end of George Kitchen's house at junction of lane, South side of Hillmorton Road, 1·73 ft. above surface	380·133

BARBY ROAD.

Mark on pier in angle of Cattle Pound, West side of Barby road, 1·19 ft. above surface	385·368
Bolt in North-West side of bridge over small stream at West side of Barby Road, 4·12 ft. above bed of stream	337·204

LAWFORD ROAD.

Mark on East battlement of bridge over Railway on Lawford Road, 1·42 ft. above surface and 3·47 ft. below top of battlement	313·020

BILTON ROAD.

Bolt in North end of cottage at West side of Bilton Road, 1·93 ft. above surface	374·364
Mark on South side of South battlement of small bridge over drain, Bilton Road, 0·22 ft. below surface	305·250
Bolt in angle of the George Hotel, at junction of Market Place and Church Street, 0·95 ft. above surface	374·029
Bolt in front of the Sheriffs Arms Inn, Church Street, Rugby, 1·11 ft. above surface	378·587

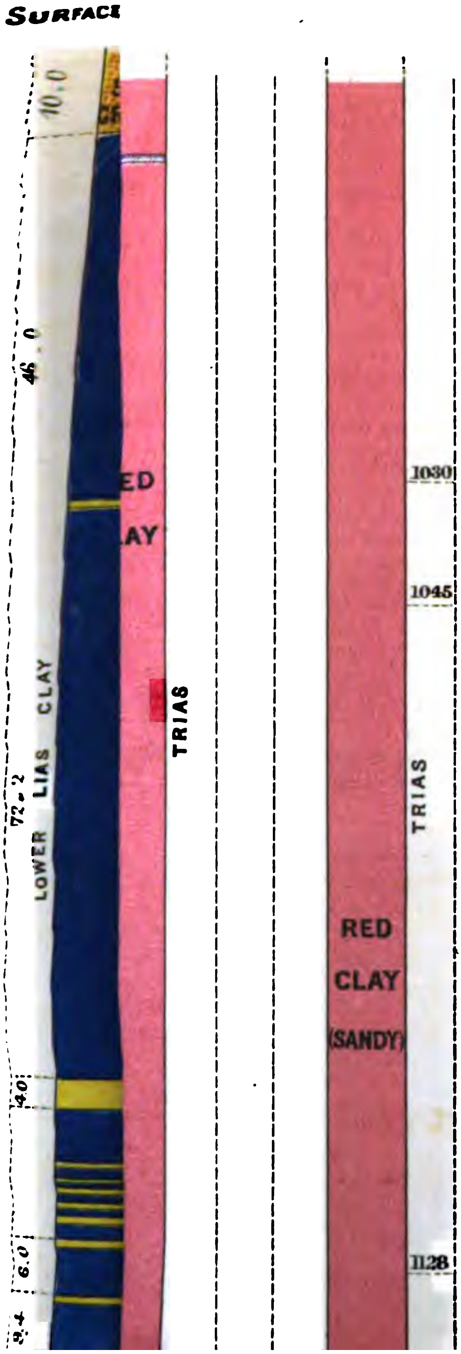
Bolt in wall at main entrance to Rugby School, opposite High Street, 1·31 feet above surface	[illegible]
Mark on South-East corner of the Butcher's Shambles, Sheep Street, 1·39 ft. above surface	[illegible]
Bolt in corner of stable at the Horse Shoe Commercial Hotel, Drury Lane, 2·05 ft. above surface	[illegible]
Bolt in front of store-house opposite the Wesleyan Chapel, Chapel Street, 0·50 ft. above surface	3[illegible]
Bolt in corner of Queen's Head Inn, at junction of Chapel Street and Little Elborow Street, 1·16 ft. above surface	3[illegible]
Bolt in North-East corner of St. Matthew's Chapel, Warwick Street, 1·06 ft. above surface	37[illegible]
Mark on corner of Doctor Sharp's house, St. Matthew Street, 1·15 ft. above surface	378
Bolt in corner of house at junction of West Street and Warwick Street, 1·35 ft. above surface	377·
Bolt in corner of house at junction of Ploughman Street and Pennington Street, 1·29 ft. above surface	376·
Bolt in front of Elias Hunt's house, at entrance to Rugby Park, North Road, 1·57 ft. above surface	357·9
Bolt in front corner of arch of bridge over the Oxford and Coventry Canal, Lutterworth Road, 1·21 ft. above surface	283·82
Mark on corner of Mr. Bushel's house, Old Station Square, 0·89 ft. above surface	296·02
Mark on front of Booking Office at Rugby Railway Station, 0·93 ft. above surface	314·257
Mark on corner of wall at entrance to Smithy, Russell Street, 1·22 ft. above surface	371·364

The Rev. T. N. Hutchinson exhibited several experiments connected with Magnetism, and displays of Electric Light in glass Tubes of various forms.

47 persons were present.

Number of Meetings held in 1868	16
Average attendance in Spring Term	41
——— Summer	40
——— Autumn	37.2
Largest Attendance	62
Smallest Attendance	21
Average Attendance for the whole year	39.5

RKS



REFERENCE TO STRATA

▒	Red Sand Gravel
■	Blue Clay
□	Lime Stone
■	Brown Clay
□	Dark Rotten Clay
■	Black Clay
░	Light Hard Stone
▓	Red Clay
▨	Blue Stone
░	Red Sand Stone

RUGBY WATER-WORKS.

REMARKS TO ACCOMPANY THE SECTION OF THE WELL.

BY J. M. WILSON.

THIS is a diagram of the strata passed through in the boring for the Artesian Well at Rugby. For the water supply of Rugby three plans were possible: one, to collect the water in the gravels, which has fallen as rain, and can be caught in drains and stored in reservoirs; another, to make a deep well and penetrate water-bearing strata below; a third, to get it from the river by means of a steam force-pump.

The first method was tried by Mr. Rammell, the engineer. The surface of the hill on which the water-tower stands was intersected by deep drains, which converge to a reservoir in the gardens near the water-tower, from which the water is pumped by the steam engine there into a large cylindrical reservoir, at the top of the Water Tower. After some years the supply fell short, the stores of water in the gravel being exhausted, and the area drained being insufficient to supply the demands of the town.

Instead of extending Mr. Rammell's plan, and draining a larger area, a fresh engineer, Mr. Hawkesley, appears to have been called in, though I am unable to find in the records of the Rugby Board of Health any record of his appointment as Engineer to the Board. He recommended the Board to make a well of considerable depth, in which he hoped water would collect. No geological opinion seems to have been obtained; and it being a familiar fact that, if a deep hole is dug in sea-sand, water collects in it, it seems to have been argued that, if a very deep hole was dug in clay at the top of a hill, water would equally be forthcoming. The boring was begun, and continued with praiseworthy perseverance to a depth far beyond that originally named by Mr. Hawkesley. The Board wrote to protest against the fruitless expenditure; the answers encouraged them to persevere. At last, when the well was about 740 feet deep (I have no memorandum of the exact figure), they stopped the boring, and refused to proceed without the opinion of a professed geologist. Ramsay was consulted, and he said they would probably pierce the water-stones at a depth between 1,100 and 1,200 feet. They persevered, and at 1,140 feet the chisel pierced the water-bearing strata, and a rush of water followed. It rose in the bore to about 160 feet from the surface, and when pumped rapidly it could be depressed to about 190 feet, but at that level the supply was rapid enough to balance the loss caused by pumping. But now a fresh misfortune occurred. The water was salt, and the more was pumped out the salter was the remainder. It was clear that the red sandstones which were pierced contained salt beds there, as they do in Cheshire and elsewhere, and that a supply of fresh water was hopeless. The water was analysed by professional chemists, and was found to contain no valuable ingredient except salt, and that in insufficient quantities to make it valuable for brine works.

Lastly, it was resolved to go to the river, and that is the plan now in work. There is a reservoir by the river, filter-beds, and a steam engine, and water is forced thence into the main pipes which run through the town. There it is raised by the head of water forced into the cistern of the Water Tower, and rises to the top of the houses.

Such is a brief outline of the Rugby Water-works, of which householders are periodically reminded when the rate collector visits them; for these interesting experiments were not performed gratuitously by the Board or the Engineers.

We, however, as a Natural History Society, have cause to be deeply grateful to the former Boards of Health for preserving the only valuable result of the boring, viz., an exact account of the strata passed through. This is accurate information of the highest value, of a kind which can be completely obtained only in this way, except under very exceptional circumstances. The accompanying lithograph presents the principal results to the eye.

The columns represent about 160 feet in depth, the one to the left being the highest. There were 10 feet of Drift Sand and Gravel, of the same kind as is to be seen at the Rugby, or New Bilton, or Hillmorton Pits. Then the clay was reached, with occasional bands of nodular limestone, not occurring with any great frequency till 200 feet was attained; from that depth to about 300 feet the limestone became more important, and below that it disappeared gradually, reappearing at the depth of 400 feet in a thick band. Below that dark clays of Rhœtic age, and then red clays and sandstones, which form the upper member of the Trias, were passed through, till the water-stones were reached, at a depth of 1145 feet.

To show the bearing of these facts on the surface geology of the district, we must remember that the strata dip toward the East and South. For example, Barby and Hillmorton, which are South and East of us, are on strata which are newer than, and rest upon, the strata on which Rugby is built. Hence Kilsby, Hillmorton, Rugby, Newbold, Newnham, are on strata of gradually increasing age. In boring, therefore, at Rugby, we shall expect to pass through, first, the strata exposed in Rugby pits, and then what are shown in the New Bilton or Newbold; then the Newnham strata: then what comes to the surface in the neighbourhood of Stretton and Stoneleigh; and finally, what is seen at Coventry or Kenilworth.

It is not difficult to identify the group of limestone strata in the diagram, at the depth of 220–270 feet, with those worked at New Bilton and Newbold; and probably the limestone reached at 400 feet is identical with that at Newnham. All the region West and North of that, for some miles, consists of the red clays and sands next passed through, and the water-stones are at the surface near Leamington and Coventry.

This section therefore gives us accurate information of the amount of dip of the lias and trias in this neighbourhood. The water-stones here are about 1000 feet lower than at Leamington, which indicates an average dip of about 1 in 60, the dip being toward the South-east. It has been valuable also as showing that, whatever the cause of the deposit of salt in the Triassic deposit really was, it was one that operated over extensive regions, and was not localized in what is now Cheshire.

Very few fossils were obtained in sinking the well, because only the first 60 or 70 feet of it was dug with the spade, and the rest bored by a chisel which reduced everything to powder. But some few lias fossils were brought up at first, and a Scotchman employed at the boring found the demand for them sufficient to justify him in sending to Whitby for a fresh supply, which I believe he sold on advantageous terms to inexperienced collectors, who could not discriminate between Upper and Lower Lias fossils.

GEOLOGICAL NOTICES.

The following additions have been made to the list of Fossils published last year. It was originally begun by Mr. WILSON, and continued by E. CLEMINSHAW, but a great majority of the specimens has been named by R. ETHERIDGE, Esq. Where no name is given the authority is E. CLEMINSHAW.

For the benefit of Geologists, the Geological Report of last year is re-published in a few copies of this year's Report.

Name of Fossil.	Newnham Regis.		Near Holbrook Grange.	Newbold.	New Bilton Limestone.	New Bilton Clay.	Dunchurch Road Pits.	Upper Hillmorton Clay.	Lower Hillmorton Clay.	Kilsby Tunnel.
	Rhætic.	Lower Lias.								
Reeds (J. D. L.)	....	....	....	....	....	—				
Montilivaltia	—									
Hemipedina (spines)	—									
Spines (J. D. L.)	....	....	....	....	....	....	....	—		
Scaphus ancylocetes	....	....	....	....	....	....	—	—		
Eryon (part of)	....	....	....	—						
Cypris	....	....	....	....	—					
Gervillia opifex	....	....	....	—	—	....	....	....	....	—
For Lima (specimen of) read Lima punctata	....	....	....	....	....	....	....	—	—	—
Ostrea arietis	....	....	...	—	....	....	....	—		
Pecten textorius	....	....	....	....	....	....	....	—	....	—
After Arca insert punctata										
Lucina sp.	—									
Myacites unionides	....	....	....	....	....	....	....	—	....	—
——— musculoides	—	....	—	—						
——— longissimus	....	....	....	....	....	....	....	—		
Dele Pleurotomaria (specimen of)	....	....	....	....	....	....	....	....	....	....
Pleurotomaria Anglica	....	....	—							
Trochus imbricatus	....	....	....	....	....	....	....	....	....	—
Ammonites angulatus	....	....	—							
A. catenatus	....	....	....	....	....	....	....	—		
A. Halecis (R. F. B.)	....	....	....	....	....	....	—	—		
A. ibex	....	....	....	....	....	....	....	....	....	—
A. maculatus	....	....	....	....	....	....	....	....	....	—
A. Sauzeanus (R. F. B.)	....	....	....	....	....	....	—			
A. Maugenisti (R. F. B.)	....	....	..	....	....	....	—			
Nautilus lineatus (R. F. B.)	....	....	....	....	....	....	—			
Pholidophorus	....	....	....	—						
Hybodus reticulatus	....	....	...	—						
Ichthyosaurus (vertebræ)	—	—								

THE Geological Album is now held by J. D. LAWE, to whom notices should be given. We extract the following from the Album:

NODULES are found in the Dunchurch Road or Rugby Pit closely resembling those which are common at Upper Hillmorton, and which have proved to be coprolites. A chemical analysis of these is much wanted. The workmen call them fossil fruits, and they consist of a number of concentric layers of fine yellow or red powder, often hard from cement, and in one instance a shell has been found inside, by F. R. Smith. In general they are hollow, or filled with a substance resembling the substance of the coating, but softer. O. L.

It has been noticed that at the Newbold Works there are two bands which contain rhynconellæ, about nine feet apart; the highest is about 10 feet below the top of the arch at present. About four feet below the lowest is the fish-scale bed, close below which is a band of limestone rich in gryphea.
A. G. O. & F. K. S.

The bed exposed at the newly-opened Lower Hillmorton clay pits is probably higher in the Lias than the pits at Upper Hillmorton; it is not so rich in fossils. The following fossils common at Upper Hillmorton are found there:—Gryphea incurva (large), G. cymbium, Ammonites Guibalianus, A. armatus, A. planocostatus, Pinna diluviana, Belemnites elongatus, B. acutus, Cardinia ovalis, Unicardium cardioides, Pholadomya ambigua, Pentacrinites Briareus, &c. The coprolitic nodules so common at Upper Hillmorton are also found. There is no drift at these new pits, although at some pits on the other side of the road it is very thick. E. C.

ORNITHOLOGICAL NOTICES.

We give a list of birds that have been observed in the neighbourhood of Rugby *at various times*, supplementary to the list in the Report for 1867. These additions bring the number of birds to 102. We also give a list of dates of the earliest eggs noticed in 1868. To the rarer birds are appended the initials of the discoverers,—A. E. Stuart, F. C. Selous, and O. Leggatt. Latin names are only given to those not mentioned in the last Report. As very few notices of Eggs were given in 1868, it is hoped that many more may be given to the President, or to N. Masterman.

I. Raptores.

(1). FALCONIDÆ.

Buteo vulgaris—Common Buzzard; Mr. C. M. Caldecott.
Arcus Cyaneus—Hen Harrier; A.E.S.
Falco Subbuteo—Hobby; A.E.S.

(2). STRIGIDÆ.

Ulula Stridula—Tawny Owl.

II. Insessores.

(7). CORVIDÆ.

Bombycilla garrula—Bohemian Wax-wing; Mr. C. M. Caldecott.

III. Scansores.

(1). PICIDÆ.

Picus major—Greater Spotted Woodpecker; A.E.S.

(2). SYLVIADÆ.

Sylvia rubicola—Stonechat; May 13; A.E.S.
" *hortensis*—Garden Warbler; May 14; F.C.S.
" *sylvicola*—Wood Warbler; A.E.S.

Parus palustris—Marsh Tit; A.E.S.
Motacilla sulphurea—Grey Wagtail; A.E.S.
Caprimulgus Europæus—Night-Jar; A.E.S.

(3). TRINGILLADÆ.

Linaria minor—Redpoll; F.C.S.

(4). MUSCICAPADÆ.

Muscicapa luctuosa—Pied Flycatcher; F.C.S.

VI. GRALLATORES.

(4). RALLIDÆ.

Grallus aquaticus—Water Rail; A.E.S.

VII. NATATORES.

(1). ANATIDÆ.

Anas Clypeata—Shoveller; F.C.S.
" *ferina*—Pochard; shot near Avon Inn.
" *virga*; Mr. Caldecott.

Kestrel; May 4; F.C.S.
Sparrowhawk; April 28; A.E.S.
Barn Owl; May 11; F.C.S.
Hedgesparrow; April 9.
Robin; April 2.
Sedgewarbler; May 11.
Reedwarbler; May 23.
Nightingale; May 15; F.C.S.
Whitethroat; May 13.
Willow-wren; May 18.
Chiffchaff; May 18.
Coletit (young); May 23.
Long-tailed Tit; April 9.
Tree Pipit; May 14.
Yellowhammer; May 5.
Tree Creeper; May 24.
Missel Thrush; March 21.
Song Thrush; March 24.
Blackbird; March 28.
Rook; March 21.
Jay; May 23.
Sand Martin; May 23.
Kingfisher (hard-set); April 13; A.E.S.
Lesser Spotted Woodpecker; May 12; O.L.
Cuckoo (in Reedwarbler's nest); May 31.
Lapwing; April 3.
Heron; March 17; F.C.S.
Coot; May 14, (young) May 23.

ENTOMOLOGICAL NOTICES.

THE Report of this Section is very scanty this year, since the Society has lost the services of G. B. LONGSTAFF. His place as keeper of the Album has not been permanently filled, but J. M. LESTER now holds the Album till some one more specially devoted to this branch can be found.

A box of Lepidoptera was presented to the Society in January, 1868, by the Rev. A. H. WRATISLAW, containing *E. Blandina*, *A. Berberata*, *T. Piniferda*, *C. Davus*, and others equally acceptable.

Though there are very few observers in this branch of Natural History, some interesting additions to the former list have been made. The first seven were all taken by G. B. LONGSTAFF:—

Hibernia progemmaria. In Coombe Wood. March 12th.
Tortricades Hyemana. Very abundant at Coombe. March 12th.
Alucita polydactyla. March 15th.
Coccyx strobilella. Bred on April 4th from fir cones collected in February.

Anisopteryx æscularia. On a tree trunk. April 4th.
Diurnea fagella. On the Dunchurch Road. April 4th.
Depressaria chærophylli. In a field near the Dunchurch Road. April 4th.
Cynthia Cardui. On the Bilton Road. June 1. J.M.L.

CORRIGENDA, in the list of Lepidoptera, published in last Report :—

Page 39. For Goneptyx read Gonepteryx.
" 38. For puberscens read pubescens.
" 41. For Tyrphœna read Triphœna.
" 42. For vividana read viridana.
" " Læflingiana read Lœflingiana.

Dele—Œcophora unitella. After Glyphiterygidæ insert Glyphipteryx furco—viridella.

NOTICES OF FIRST APPEARANCE, &c.

Vanessa urticæ. First seen April 2nd. J.L. and C.B.
Pieris Rapæ. First seen April 4th. J.L. and J.M.L.
2 *Vanessæ* (Species?) Seen April 4th. G.B.L.
Depressaria applana. First seen near Newbold, April 6th. G.B.L.
Lycæna phlæas. First observed in Swift's Meadows, May 15th. J.P.B.
Melitæa silene. First observed in Frankton Wood, May 26th. J.M.L.
Cynthia cardui. First observed on the Bilton Road, June 1st. J.M.L.
Hipparchia janira. First observed on the Bilton Road, June 14th. J.M.L.
Hipparchia megæra. First observed on the Bilton Road, June 14th. J.M.L.
Argynnis Paphia. First seen in Frankton Wood, July 25th. J.M.L.
Satyrus Œgeria. First seen in Frankton Wood, July 25th. J.M.L.
Vanessa Atalanta. First seen, June 13th. J.M.L.
Bees on wing, May 3. N.M.
Wasps seen, Feb. 24th. J.M.L. and F.E.K.
Gonepteryx Rhamni. Feb. 25th. F.R.S.

As a Collection is being made of observations as to the first appearances of insects, &c., in 1869, such observations may be handed in to J. M. LESTER.

BOTANICAL NOTICES.

OUR Plants have been very carefully noticed this last year by the various members of the Botanical Section. Yet, as must nearly always be the case, some few have not been noticed at all (especially those that grow only at a long distance off); and also some have not been noticed at the time they first came out, for the same reason; so that only an approximate date can be recorded. In such cases a "by" has been prefixed to the date, to signify that it was first seen on that day, but had been in flower for some time before.

It is to be regretted that a suggestion made in the last Report —to note what flowers are still in blossom on October 1st, November 1st, and December 1st,—has not been carried out. The suggestion has been acted on at Marlborough, with some interesting results, which may be seen in the Marlborough Report for Christmas, 1868.

As we now wish to keep a List of the Flowers that grow in the separate Districts, it is requested that, as far as possible, against each flower, as it is recorded in bloom, may be added the letter of the District in which it was found. The following are the letters, and the Districts they represent:—

The Red Sandstone District	a
Banks of Railways and Canals, and Pits	b
The River and the alluvial soils near it	c
Between the Lawford and Dunchurch Roads	d
" " Dunchurch and Upper Hillmorton Roads	e
" " Upper Hillmorton and Clifton Roads	f
" " Clifton and Coton Roads	g
" " Coton and Newbold Roads	h
" " Newbold and Lawford Roads	k

It is not pretended that the few observations of Districts, given with the list of flowers, are of any value; but this beginning may lead to more valuable results next year.

Observers are reminded that notices of flowering times, and of localities, must be accompanied by a plant, for verification. Such notices and plants should be given, *as soon as possible*, to Mr. KITCHENER, or F. R. SMITH.

NEW PLANTS.

The following Plants have been found for the first time in the Rugby District. The names, and the numbers before the specific names, are taken from the *London Catalogue of British Plants* (sixth edition).

Fam. 5; *Reseda* 126 *lutea*, Linn., b, Wild Mignonette; on the Leamington Railway bank; 15th July; F.R.S.

Fam. 18; *Geranium* 240 *sanguineum*, Linn., k, Bloody Geranium (escaped from cultivation); near Holbrook Grange; May 23rd; H.W.S.

Fam. 23; *Trifolium* 272 *medium*, Linn., d; Frankton Wood; 27th July; E.C.

Fam. 25; *Epilobium* 367 *angustifolium*, Linn., ab; (before only known to grow at Frankton) at Lower Hillmorton; September 22nd; F.R.S.

Fam. 26; *Ceratophyllum* 387 *demersum*, Linn., b; Old Canal near Brownsover; September 23rd; F.R.S.

Fam. 44; *Carduus* 600 *eriophorus*, Linn., d; (recovered) near Birdingbury Station; July 27th; F.R.S.

Fam. 44; *Carduus* 606 *acaulis*, Linn., g; (recovered) near Brownsover Mill.

Fam. 53; *Veronica* 757 *(montana)*, Linn., a; Coombe Woods, near Brinklow; May; H.C.L.R.

Fam. 53; *Linaria* 782 *(spuria)*, Mill, d; near Birdingbury Station; July 27th; H.C.L.R.

Fam. 53; *Linaria (Elatine)*, Mill, d; same locality and date; H.C.L.R.

Fam. 56; *Anchusa* 864 *sempervirens*, Linn.; near Newbold Grange (escaped from cultivation); May 5th; F.R.S.

Fam. 62; *Chenopodium* 909 *a. acutifolium*, Linn., g; near Brownsover Hall; August 20th; H.C.L.R.

Fam. 71; *Salix* 1014 *laurina*, Sm., g; Old Canal near Brownsover; Aug. 20th; Rev. A. Bloxam.

Fam. 77; *Paris* 1103 *(quadrifolia)*, Linn., a; Coombe Woods, near Brinklow; May; H.C.L.R.

Fam. 84; *Juncus* 1151 *diffusus*, Hoppe; Canal near Rugby Wharf; Autumn, 1867; Rev. A. Bloxam.

Fam. 85; *Eriophorum* 1201 *polystachyon*, Linn., b; Leamington Railway bank; May 31st; H. Field.

Fam. 86; *Molinia* 1319 *(cærulea)*, Moench, d; Frankton Wood; July 27th; H.C.L.R.

For the benefit of Botanists, a List of Plants is given underneath, that grow about Coleshill, near Birmingham, a good place for excursions from Rugby. None of these plants now grow near us. This list is confessedly very imperfect, as, Coleshill being rather far from Rugby, only very few observations have been made.

COLESHILL PLANTS.

Fam. 7, *Viola* 132 *palustris*, Linn.
Fam. 8, *Drosera* 138 *rotundifolia*, Linn.
Fam. 16, *Hypericum* 223 *elodes*, Linn.
Fam. 24, *Comarum* 334 *palustre*, Linn.
Fam. 38, *Hydrocotyle* 441 *vulgaris*, Linn.
Helosciadium 455 *inundatum*, Koch.
Fam. 41, *Galium* 516 *uliginosum*, Linn.
Fam. 44; *Carduus* 604 *pratensis*, Huds.
Solidago 642 *Virgaurea*, Linn.
Fam. 45, *Erica* 692 *cinerea*, Linn.
Fam. 53, *Veronica* 753 *scutellata*, Linn.
Pedicularis 772 *palustris*, Linn.
Fam. 55, *Scutellaria* 846 *minor*, Linn.
Fam. 60, *Plantago* 905 *coronopus*, Linn.
Litorella 906 *lacustris*, Linn.
Fam. 76, *Narthecium* 1095** *ossifragum*, Huds.
Fam. 81, *Potamogeton* 1132 *plantagineus*, Ducros.
Zannichelli a. 1136 *palustris*, Linn.
Fam. 85, *Rhyncospora* 1180 *alba*, Vahl.
Scirpus 1186 *setaceus*, Linn.
" 1197 *acicularis*, Linn.
" 1198 *fluitans*, Linn.
Carex 1238 *distans*, Linn.
" 1252 *pilulifera*, Linn.
" 1258 *ampullacea*, Good.
And many other *Carices*.
Fam. 89, *Pilularia* 1419 *globulifera*.

For the purpose of comparing the Plant Register for 1868 with that for 1867, the latter is re-published in a few copies of this year's Report.

From the Botanical Album:—

In February, 1868, a Birch Tree in Mr. Wilson's garden was accidentally injured in one of its higher branches, some 20 feet or more from the ground. It began bleeding profusely, and had been bleeding for more than 24 hours when I observed it; it then was bleeding at the rate of 15 drops a minute. I collected more than a teaspoonful of this ascending sap. Some was lost in straining, but on trying Hydrate of Baryta with it, there was found sufficient free Carbonic acid to give traces of Carbonate of Baryta. This was weighed by Mr. Hutchinson, who writes "there was only about ·01 grain of Carbonic acid present, the amount of sap being close upon one fluid oz."

F. E. K.

Register of Plants for 1868.

To prevent mistakes in synonyms, this Register will be hereafter given according to the *London Catalogue of British Plants*, 6th edition, 1867, price 6d.

1. RANUNCULACEÆ.

		Date when first seen in flower.	Districts.	By whom recorded.
Thalictrum	4. flavum, Linn.	June 6	dg	F.R.S.
Anemone	6. nemorosa, Linn.	March 14	ade	L.E.M.
Ranunculus	11. a. peltatus, Fries.	April 4	ae	H.C.L.R.
	11. circinatus, Sibth.	by July 26	a	E.C.
	13. hederaceus, Linn.	by June 12,	ef	F.R.S.
	14. Ficaria. Linn.	February 23	df	H.C.L.R.
	15. Flammula, Linn.	by July 24	dfg	F.R.S.
	18, auricomus, Linn.	April 14	dfg	H.C.L.R.
	19. acris, Linn.	April 22	f	H.C.L.R.
	20. repens, Linn.	June 5	eg	F.E.K.
	21. bulbosus, Linn.	April 26	ek	H.C.L.R.
	23. sceleratus, Linn.	February 23	f	H.C.L.R.
	25. arvensis, Linn.	June 1	de	E.C.
Caltha	26. palustris, Linn.	March 19	defgk	C.J.E.S.
Helleborus	30. *fœtidus*, Linn.	March 16		F.R.S.
Aquilegia	31. *vulgaris*, Linn.	March 30		W.Y.N.

1*. BERBERACEÆ.

Berberis	35. vulgaris, Linn.	May 4	dg	F.R.S.

2. NYMPHÆACEÆ.

Nuphar	37. lutea, Sm.	June 1	cd	F.E.K.

3. PAPAVERACEÆ.

Papaver	40. Argemone, Linn.	May 23	k	F.R.S.
	41. dubium, Linn.	June 6	d	F.R.S.
	42. Rhœas, Linn.	June 8	d	F.R.S.
Chelidonium	45. majus, Linn.	May 26	f	H.W.S.

3*. FUMARIACEÆ.

Corydalis	49. *lutea*, D.C.	May 23		F.R.S.
Fumaria	51. officinalis, Linn.	April 19	fg	H.C.L.R.

4. CRUCIFERÆ.

Coronopus	58. Ruellii, Gaert.	June 7	gk	F.R.S.
Thlaspi	60. arvense, Linn.	July 29		E.C.
Capsella	63. Bursa-pastoris, D.C.	February 28	all	F.E.K.
Teesdalia	65. nudicaulis, Br.	April 10	f	F.E.K.
Lepidium	67. *latifolium*, Linn.	May 12		E.C.
	70. campestre, Br.	May 4	d	F.R.S.
Draba	79. verna, Linn.	March 3	def	F.R.S.
Cardamine	84. amara, Linn.	May 1	k	H.C.L.R.
	85. pratensis, Linn.	March 26	efg	H.C.L.R.
	86. hirsuta, Linn.	by March 9	g	G.B.L.
Arabis	88. thaliana, Linn.	May 12	d	F.R.S.
Barbarea	95. vulgaris, Br.	May 4	d	F.R.S.
Nasturtium	98. officinale, Br.	May 23	dg	F.R.S.
	99. terrestre, Br.	May 23	k	F.R.S.
	101. amphibium, Br.	May 25	gh	H.W.S.

		Date when first seen in flower.	Districts.	By whom recorded.
Sisymbrium	102. officinale, Scop.	May 1	k	H.C.L.R.
Erysimum	107. Alliaria, Linn.	April 16	f	H.C.L.R.
Brassica	114–.Campestris, Linn.	March 29		H.C.L.R.
Sinapis	116. arvensis, Linn.	March 30		F.R.S.
	5. RESEDACEÆ.			
Reseda	126. lutea, Linn.	by May 31	b	H.F.
	7. VIOLACEÆ.			
Viola	133. odorata, Linn.	February 25	dhf	G.H.H.
	134. hirta, Linn.	March 26	h	H.C.L.R.
	135–.sylvatica, Fries	April 4	d	H.C.L.R.
	136–.arvensis, Murr.	March 16	g	O.L.
	9. POLYGALACEÆ.			
Polygala	141. vulgaris, Linn.	May 25	f	F.E.K.
	12. CAROPHYLLACEÆ.			
Silene	152. inflata, Sm.	by July 27	g	E.C.
Lychnis	162. Flos-cuculi, Linn.	May 18	defg	R.D.
	163. diurna, Sibth.	May 4	d	F.R.S.
	164. Vespertina, Sibth.	May 12	de	F.R.S.
	165. Githago, Lam.	June 21	df	H.W.S.
Sagina	167. apetala, Auct.	May 5	e	F.R.S.
	168. procumbens, Linn.	by April 29	e	H.C.L.R.
	171. nodosa, Meyer	by May 13		F.R.S.
Spergula	172. arvensis, Linn.	by June 19	f	F.R.S.
Spergularia	175. rubra, Fenzl	May 6	f	F.R.S.
Arenaria	178. serpyllifolia, Linn.	June 8	d	F.R.S.
	182. trinervis, Linn.	March 30	ef	G.H.H.
Stellaria	185. media, With.	by Feb. 2	all	F.R.S.
	186. Holostea, Linn.	May 5	aef	F.R.S.
	188. graminea, Linn.	by May 25	d	F.E.K.
	189. uliginosa, Murr.	May 20	ef	C.J.E.S.
Cerastium	191. aquaticum, Linn.	by July 2	g	F.R.S.
	192. glomeratum, Thuill.	March 13	d	F.R.S.
	193. triviale, Link.	by Feb. 16		F.R.S.
	13. LINACEÆ.			
Linum	202. catharticum, Linn.	May 26	b	F.R.S.
	14. MAEVACEÆ.			
Malva	204. moschata, Linn.	June 20	d	F.R.S.
	205. sylvestris, Linn.	by June 4	f	R.D.
	206. rotundifolia, Linn.	by July 18	d	E.C.
	15. TILIACEÆ.			
Tilia	211. *parvifolia*, Ehrh.	by July 5		F.R.S.
	212. *intermedia*, D.C.	June 23		E.C.
	16. HYPERICACEÆ.			
Hypericum	215. perforatum, Linn.	June 23	k	E.C.
	216. quadrangulum, Auct.	June 25	k	F.R.S.
	216. dubium, Leers.	by July 24	f	F.R.S.
	218. humifusum, Linn.	by August 25	df	F.R.S.
	220. pulchrum, Linn.	June 27	f	R.D.
	221, hirsutum, Linn.	July 4	k	E.C.

17. ACERACEÆ.

			Date when first seen in flower.	Districts.	By whom recorded.
Acer	225.	*campestre*, Linn.	July 20		F.R.S.
	226.	*Pseudo-platanus*, Lin.	May 18		F.E.K.

18. GERANIACEÆ.

Geranium	229.	*phæum*, Linn.	May 11	d	F.R.S.
	231.	pratense, Linn.	June 1	d	F.R.S.
	234.	pusillum, Linn.	April 30		F.E.K.
	235.	molle, Linn.	May 5	f	F.R.S.
	236.	dissectum, Linn.	June 3	d	F.R.S.
	238.	lucidum, Linn.	April 24	d	H.C.L.R.
	239.	Robertianum, Linn.	May 12	ef	H.P.D.
	240.	*sanguineum*, Linn.	May 23	k	H.W.S.

20. OXALIDACEÆ.

Oxalis	243.	Acetosella, Linn.	March 24	d	H.C.L.R.

22. RHAMNACEÆ.

Rhamnus	246.	catharticus, Linn.	June 1		F.E.K.

23. LEGUMINIFERÆ.

Sarothamnus	248.	scoparius, Koch.	April 30	b	H.C,L.R.
Ulex	249.	europæus, Linn.	by February 2	all	F.R.S.
Ononis	254.	spinosa, Linn.	June 19	ek	E.C.
Anthyllis	257.	vulneraria, Linn.	May 25	b	E.C.
Medicago	258.	*sativa*, Linn.	June 26		H.C.L.R.
	260.	lupulina, Linn.	by April 11	def	H.C.L.R.
Melilotus	264.	officinalis, Willd.	June 8	bh	E.C.
Trifolium	267.	repens, Linn.	May 26	d	F.R.S.
	271.	pratense, Linn.	May 1	e	H.C.L.R.
	272.	(medium), Linn.	by July 27	d	E.C.
	273.	*hybridum*, Linn.	June 27	fk	F.R.S.
	280.	fragiferum, Linn.	by July 27	d	F.R.S.
	281.	procumbens, Linn.	June 26	e	E.C.
Lotus	283.	corniculatus, Linn.	May 16		H.W.S.
	284.	major, Scop.	by July 27	d	F.R.S.
Ornithopus	291.	perpusillus, Linn.	by July 30	f	E.C.
Vicia	297.	Cracca, Linn.	June 3	fh	R.D.
	298–.	*en-sativa*, Syme, E.B.	May 9	a	G.H.H.
	298–b.	(Bobartii), Forst.	May 30	a	F.R.S.
	301.	sepium, Linn.	April 26	d	H.C.L.R.
	303.	hirsuta, Koch.	May 9	bf	G.H.H.
Lathyrus	308.	pratensis, Linn.	May 25	ab	F.R.S.
Orobus	312.	(tuberosus), Linn.	May 30	a	F.R.S.

24. ROSACEÆ.

Prunus	314–.	spinosa, Linn.	April 2	k	R.D.
	314–.	insititia, Linn.	March 30		H.C.L.R.
	316.	Cerasus, Auct., var.	April 4	d	N.M.
Spiræa	317.	Ulmaria, Linn.	by June 13	df	F.E.K.
	318.	Filipendula, Linn.	by June 13	dh	F.E.K.
Geum	321.	urbanum, Linn.	May 4	ef	F.R.S.
	322.	(rivale), Linn.	April 30	ad	F.E.K.

			Date when first seen in flower.	Districts.	By whom recorded.
Potentilla.........	327.	anserina, Linn..........	May 18.........	defg	H.W.S.
	331.	reptans, Linn.	May 24.........	f	H.W.S.
	332.	Tormentilla, Schenk...	April 30	df	H.C.L.R.
	333.	Fragariastrum, Ehrh.	April 18	d	H.C.L.R.
Fragaria	935.	vesca, Linn.	March 29......	d	H.C.L.R.
Rubus	339.	Idæus, Linn.............	May 25.........		F.E.K.
	340.	cæsius, Linn.............	June 20.........	k	E.C.
	340*.	fruticosus, Auct., var.	May 23.........	all	F.R.S.
Rosa	351.	canina, Auct.	May 26.........		F.R.S.
	353.	arvensis, Linn.	June 6	d	F.R.S.
Agrimonia	354.	Eupatoria, Linn.	by June 26 ...	k	E.C.
	354b.	odorata, Mill.	June 4	k	E.C.
Sanguisorba ...	354*.	officinalis, Linn.......	May 1	g	H.C.L.R.
Poterium	355.	Sanguisorba, Linn. ...	June 12.........		A.N.
	355*.	*muricatum*, Spach....	May 23.........	b	F.R.S.
Alchemilla	356.	vulgaris, Linn..........	April 25	d	H.C.L.R.
	358.	arvensis, Scop.	May 5	df	F.R.S.
Cratægus.........	360.	Oxyacantha, Linn. ...	by May 1	all	F.E.K.
Pyrus	363b.	*mitis*	May 2	d	F.R.S.
	366.	Aucuparia, Gaertn. ...	April 4		F.E.K.
		25. ONAGRACEÆ.			
Epilobium	367.	angustifolium, Linn...	June 27.........	bd	F.R.S.
	368.	hirsutum, Linn.	June 24.........	defg	E.C.
	369.	parviflorum, Schreb....	July 40.........		F.R.S.
	370.	montanum, Linn.......	June 25.........	h	F.E.K.
	372.	palustre, Linn.	June 25.........		E.C.
	373.	tetragonum, "Linn," Benth..................	June 25.........	k	F.R.S.
Circæa	377.	lutetiana, Linn..........	June 27.........	ad	E.C.
		26. HALORAGIACEÆ.			
Callitriche	383.	verna, Linn.	May 13.........	efh	F.E.K.
Ceratophyllum..	387.	demersum, Linn.	by Sept. 23 ...	h	F.R.S,
		27. LYTHRACEÆ.			
Lythrum	390.	Salicaria, Linn..........	June 24.........	dk	E.C.
		29. CUCURBITACEÆ.			
Bryonia	393.	dioica, Linn.	June 20.........	ad	F.R.S.
		32. SCLERANTHACEÆ.			
Scleranthus......	399.	annuus, Linn.............	by July 27 ...	d	F.R.S.
		33. GROSSULARIACEÆ.			
Ribes...............	403.	(*nigrum*), Linn.	by June 26 ...	dg	H.C.L.R.
	404.	*rubrum*, Linn.	April 3	dg	H.C.L.R.
	406.	*Grossularia*, Linn. ...	March 26......	d	F.R.S.
		84. GRASSULACEÆ.			
Sedum	414.	acre, Linn................	June 20.........	k	F.R.S.
		35. SAXIFEAGACEÆ.			
Saxifraga.........	427.	granulata, Linn.	May 20.........	g	R.D.
	480.	tridactylites, Linn. ...	April 4	df	H.C.L.R.
		36. ARALIACEÆ.			
Hedera	438.	Helix, Linn.	September 22	all	E.C.

37. CORNACEÆ.

		Date when first seen in flower.	Districts.	By whom recorded.
Cornus	439. sanguinea, Linn.	June 6	dk	F.R.S.

38. UMBELLIFERÆ.

Sanicula	442. europæa, Linn.	April 18	d	H.C.L.R.
Conium	446. maculatum, Linn.	June 28	b	F.R.S.
Helosicadium	454. nodiflorum, Koch.	June 22	h	F.R.S.
Sison	456. Amomum, Linn.	July 26		E.C.
Ægopodium	457. Podagraria, Linn.	May 20		F.E.K.
Carum	458. (*Carui*), Linn.	June 30	b	F.R.S.
Bunium	461. flexuosum, With.	by May 14	gk	F.E.K.
Pimpinella	462. Saxifraga, Linn.	July 26	b	E.C.
Sium	464. latifolium, Linn.	by July 3	g	F.R.S.
Œnanthe	470. fistulosa, Linn.	June 24	e	F.R.S.
	474. Phellandrium, Lam.	by July 26		E.C.
Æthusa	475. Cynapium, Linn.	by June 27	f	E.C.
Silaus	479. pratensis, Bess.	July 23	b	E.C.
Angelica	482. sylvestris, Linn.	June 13		F.R.S.
Pastinaca	486. sativa, Linn.	May 25	b	F.R.S.
Heracleum	487. sphondylium, Linn.	March 5	d	H.P.D.
Daucus	489. Carota, Linn.	June 17	b	F.R.S.
Torilis	493. Anthriscus, Gaertn.	June 20	b	E.C.
	494. infesta, Spreng.	June 24	k	F.E.K.
	495. nodosa, Gaertn.	June 16	k	F.E.K.
Scandix	496. Pecten-Veneris, Linn.	April 4	f	H.C.L.R.
Anthriscus	498. sylvestris, Hoffm.	March 9	d	C.S.R.
Chærophyllum	500. temulum, Linn.	by May 14	d	F.E.K.

40. CAPRIFOLLACEÆ.

Sambucus	504. nigra, Linn.	May 26	defg	H.W.S.
Viburnum	506. Opulus, Linn.	June 26	d	F.R.S.
Lonicera	508. Periclymenum, Linn.	May 30	defg	R.D.

41. RUBIACEÆ.

Galium	513. verum, Linn.	June 13	f	E.C.
	514. cruciatum, With.	April 17	df	H.C.L.R.
	515. palustre, Linn.	June 13		F.R.S.
	517. saxatile, Linn.	May 25	f	F.E.K.
	523. Aparine, Linn.	May 16	f	H.W.S.
Sherardia	526. arvensis, Linn.	May 1	f	H.C.L.R.
Asperula	527. odorata, Linn.	April 9	k	H.C.L.R.

42. VALERIANACEÆ.

Valeriana	531. dioica, Linn.	May 23	f	R.D.
	532. officinalis, Linn.	by June 27	d	F.R.S.
Valerianella	534. olitoria, Moench	May 5		F.R.S.

43. DIPSACEÆ.

Dipsacus	539. sylvestris, Linn.	June 21	k	H.W.S.
Scabiosa	541. succisa, Linn.	by July 23	f	E.C.
Knautia	543. arvensis, Coult	by July 23	g	E.C.

44. COMPOSITÆ.

Tragopogon	544. pratensis, Linn.	May 30	f	F.R.S.
Hypochœris	553. radicata, Linn.	May 25	a	F.E.K.
Lactuca	557. (muralis), "D.C."	June 20		F.R.S.

			Date when first seen in flower.	Districts.	By whom recorded.
Sonchus	559.	arvensis, Linn.	June 2	k	F.R.S.
	560.	asper, Hoffm.	May 25	e	F.R.S.
	561.	oleraceus, Linn.	June 3	fg	F.E.K.
Crepis	563.	virens, Linn.	May 30	g	R.D.
Hieracium	568.	Pilosella, Linn.	June 15	g	F.R.S.
	573.	sylvaticum, Sm.	June 24	d	F.R.S.
	584.	umbellatum, Linn.	June 24	dh	E.C.
Taraxacum	588.	officinale, Wigg.	February 2	all	G.B.L.
Lapsana	590.	communis, Linn.	June 15	d	F.R.S.
Cichorium	591.	Intybus, Linn.	in seed Aug. 20	h	E.C.
Arctium	592.	Lappa et Bardana	June 6		F.R.S.
Carduus	595.	nutans, Linn.	June 5	g	F.R.S.
	596.	crispus, Linn.	June 24	h	F.R.S.
	599.	lanceolatus, Linn.	June 17	f	F.R.S.
	600.	eriophorus, Linn.	July 27	d	F.R.S.
	601.	palustris, Linn.	June 6	d	F.R.S.
	602.	arvensis, Curt.	June 20	d	F.R.S.
	606.	acaulis, Linn.	July 23	g	F.R.S.
Centaurea	611.	nigra, Linn.	June 2	g	R.D.
	612.	Cyanus, Linn.	June 28	dg	F.R.S.
	613.	Scabiosa, Linn.	June 23	g	E.C.
Artemisia	626.	vulgaris, Linn.	July 27	d	H.C.L.R.
Gnaphalium	632.	uliginosum, Linn.	July 1	f	F.R.S.
Filago	635.	germanica, Linn.	July 17	f	F.R.S.
Petasites	636.	vulgaris, Desf.	March 15	f	F.R.S.
Tussilago	637.	Farfara, Linn.	June 22	all	J.A.
Senecio	643.	vulgaris, Linn.	by February 5	all	F.E.K.
	644.	sylvaticus, Linn,	by July 27	d	H.C.L.R.
	647.	erucæfolius, Linn.	by July 27	d	F.R.S.
	648.	Jacobæa, Linn.	June 22	f	F.R.S.
	649.	aquaticus, Huds.	June 23	g	F.R.S.
Inula	658.	dysenterica, Linn.	July 23	d	F.E.K.
Bellis	660.	perennis, Linn.	February 2	all	F.R.S.
Chrysanthemum	661.	segetum, Linn.	June 1	f	F.R.S.
	662.	Leucanthemum, Linn.	May 16	g	H.W.S.
	663.	*Parthenium*, Pers.	June 28	d	E.C.
	663*.	Tanacetum, Syme.	July 17	g	E.C.
	664.	inordum, Linn.	May 6	df	H.W.S.
	665.	Chamomilla, E. Mey.	May 14		J.D.A.
Anthemis	669.	Cotula, Linn.	June 23	f	R.D.
Achillea	670.	Ptarmica, Linn.	June 2	g	E.C.
	671.	Millefolium, Linn.	May 30	dg	F.R.S.

45. CAMPANULACEÆ.

Campanula	675.	rotundifolia, Linn.	June 16	f	E.C.
	678.	latifolia, Linn.	by June 24	a	E.C.
Jasione	687.	montana, Linn.	June 27	f	R.D.

46. ERICACEÆ.

Erica	690.	Tetralix, Linn.	by July 27	d	H.C.L.R.
Calluna	695.	vulgaris, Salisb.	by July 27	d	H.C.L.R.

47. ILICACEÆ.

Ilex	713.	Aquifolium, Linn.	May 4	e	F.R.S.

48. JASMINACEÆ.

			Date when first seen in flower.	Districts.	By whom recorded.
Ligustrum	714.	vulgare, Linn.	June 13	d	E.C.
Fraxinus	715.	excelsior, Linn.	April 4	k	F.E.K.

49. APOCYNACEÆ.

Vinca	716.	*minor*	March 29	d	H.C.L.R.

50. GENTIANACEÆ.

Erythræa	724.	Centaurium, Per.	June 22	b	E.C.

51. CONVOLVULACEÆ.

Convolvulus	729.	Arvensis, Linn.	June 3	k	G.H.H.
	730.	Sepium, Linn.	by June 4	k	F.R.S.

52. SOLANACEÆ.

Solanum	738.	Dulcamara, Linn.	May 23	d	R.D.
Datura	—.	*Stramonium*, Linn.	August 20		H.C.L.R.
Lycium	—.	*barbarum*, Linn.	by July 27		F.R.S.

53. SCROPHULARIACEÆ.

Verbascum	740.	(Thapsus), Linn.	June 20		E.C.
Veronica	747.	arvensis, Linn.	February 22	fk	H.C.L.R.
	750.	serpyllifolia, Linn.	by May 1	f	F.E.K.
	754.	Anagallis, Linn.	May 23	k	F.R.S.
	755.	Beccabunga, Linn.	May 10	all	C.S.R.
	756.	officinalis, Linn.	May 24	d	H.W.S.
	757.	*(montana)*, Linn.	May 5	a	H.C.L.R.
	758.	Chamædrys, Linn.	April 14	fk	H.C.L.R.
	759.	hederæfolia, Linn.	by February 5	b	F.E.K.
	760.	agrestis, Linn.	March 14	e	G.B.L.
	761.	polita, Fries.	March 14		G.B.L.
	762.	*Buxbaumii*, Ten.	March 8		G.H.H.
Bartsia	765.	Odontites, Huds.	July 12	k	E.C.
Rhinanthus	767.	Crista-galli, Linn.	March 19	g	H.W.S.
Melampyrum	770.	(pratense), Linn.	May 30	a	F.R.S.
Pedicularis	773.	sylvatica, Linn.	May 30	a	F.R.S.
Scrophularia	774.	nodosa, Linn.	May 30	o	F.R.S.
	775.	aquatica, 'Linn.' Benth.	May 30	c	F.R.S.
Digitalis	778.	purpurea, Linn.	May 30	ef	H.W.
Linaria	782.	spuria, Mill.	July 27	d	H.C.L.R.
	783.	elatine, Mill.	July 27	d	H.C.L.R.
	785.	vulgaris, Mill.	June 21	f	F.R.S.

55. LAMIACEÆ.

Lycopus	801.	europæus, Linn.	July 9	bo	E.C.
Mentha	806.	aquatica, Linn.	by July 22	o	E.C.
	807.	sativa, Linn.	by July 20		E.C.
	808.	arvensis, Linn.	by July 18		F.R.S.
Thymus	810.	Serpyllum, Linn.	June 7	g	E.C.
Calamintha	815.	Clinopodium, Spenn.	July 4	k	W.H.S.
Teucrium	818.	Scorodonia, Linn.	by July 24	af	E.C.
Ajuga	822.	reptans, Linn.	by April 30	g	H.C.L.R.
Ballota	825.	nigra, Linn.	June 28	d	F.R.S.

			Date when first seen in flower.	Districts.	By whom recorded.
Lamium	827.	Galeobdolon, Crantz.	May 30	e	E.C.
	828.	album, Linn.	by March 14	all	G.B.L.
	829.	*(maculatum)*, Linn.	April 25	d	H.C.L.R.
	830.	amplexicaule, Linn.	by April 26	g	F.E.K.
	831.	purpureum, Linn.	February 8	all	F.E.K.
	831*.	incisum. Willd.	February 25		H.C.L.R.
Galeopsis	832.	Ladanum, Linn.	by July 27	d	E.C.
	835.	Tetrahit, Linn.	by July 4	f	E.C.
Stachys	836.	Betonica, Benth.	June 28	d	F.R.S.
	837.	palustris, Linn.	June 16	c	F.R.S.
	838.	sylvatica, Linn.	May 30	d	R.D.
Nepeta	841.	Glechoma, Benth.	March 19	d	J.M.L.
	842.	Cataria, Linn.	July 25	g	F.R.S.
Marrubium	843.	vulgare, Linn.	July 1	k	F.R.S.
Prunella	844.	vulgaris, Linn.	June 6	f	F.R.S.
Scutellaria	845.	galericulata, Linn.	June 16	c	E.C.

56. BORAGINACEÆ.

Myosotis	847.	palustris, With.	by May 21	g	F.R.S.
	852.	arvensis, Hoffm.	April 4	e	R.D.
	854.	versicolor, Lehm.	June 13	f	F.R.S.
Lithospermum	856.	arvense, Linn.	May 20	dh	F.E.K.
Symphytum	859.	officinale, Linn.	June 14	g	F.R.S.
Anchusa	864.	*sempervirens*, Linn.	May 5	k	F.R.S.
Echium	869.	(vulgare), Linn.	by June 20	a	F.R.S.

58. PINGUICULACEÆ.

Primula	878.	vulgaris, Huds.	February 25	e	F.E.K.
	880.	veris, Linn.	April 2	d	G.H.H.
Lysimachia	888.	nummularia, Linn.	June 27	c	F.R.S.
	889	(nemorum), Linn.	June 6	d	H.W.S.
Anagallis	890.	arvensis, Linn.	May 14	f	H.P.D.

60. PLANTAGINACEÆ.

Plantago	901.	major, Linn.	June 23	eg	F.R.S.
	902.	media, Linn.	May 25	dk	F.R.S.
	903.	lanceolata, Linn.	April 26	all	F.E.K.

62. CHENOPODIACEÆ.

Chenopodium	911.	rubrum, Linn.	by August 20	f	E.C.
	914.	album, Linn.	June 7	f	E.C.
	917.	Bonus-Henricus, Linn.	by July 27	d	F.R.S.
Atriplex	923.	patula, Linn.	June 6	f	F.R.S.
	923a.	augustifolia, Sm.	June 8		F.R.S.

63. POLYGONACEÆ.

Polygonum	933.	amphibium, Linn.	July 5	f	F.R.S.
	933b.	terrestre	July 5		F.R.S.
	935.	Persicaria, Linn.	June	k	E.C.
	937.	Hydropiper, Linn.	by June 26	d	H.C.L.R.
	939.	aviculare, Linn.	by June 28	e	E.C.
	941.	Convolvulus, Linn.	June 7	e	F.R.S.
Rumex	944.	crispus, Linn.	June 15	d	F.R.S.
	948*.	conglomeratus, Mur.	June 15	g	F.R.S.
	951.	Acetosa, Linn.	May 1	f	H.C.L.R.
	952.	Acetosella, Linn.	May 1	f	H.C.L.R.

65. THYMELÆACEÆ.

			Date when first seen in flower.	Districts.	By whom recorded.
Daphne	955.	Laureola, Linn.	by March 21...	d	C.T.C.

69. EUPHORBIACEÆ.

Euphorbia	962.	Helioscopia, Linn.	February 22...	f	H.C.L.R.
	968.	Cyparissias, Linn.	June 24	d	F.R.S.
	971.	exigua, Linn.	June 23	f	E.C.
	972.	Peplus, Linn.	by April 27 ...	g	H.C.L.R.
	973.	*(Lathyris)*, Linn.	by July 26 ...	a	F.R.S.
Buxus	975.	sempervirens, Linn.	March 9		F.R.S.
Mercurialis	976.	perennis, Linn.	March 9	e	L.E.M.

70. URTICACEÆ.

Urtica	978.	urens, Linn.	May 20	all	F.E.K.
	979.	dioica, Linn.	May 14	all	F.E.K.
Parietaria	982.	officinalis, Linn.	June 20	g	F.R.S.
Humulus	983.	Lupulus, Linn.	by July 27 ...	d	F.R.S.

71. AMENTIFERÆ.

Ulmus	985a.	campestris, Sm.	February 24...		H.C.L.R.
Quercus	988.	pedunculata, Ehrh.	May 4		F.R.S.
Carpinus	990.	Betulus, Linn.	March 20		F.R.S.
Corylus	991.	Avellana, Linn.	February 20...	f	H.C.L.R.
Betula	993.	alba, Linn.	April 4		F.E.K.
Populus	995.	alba, Linn.	February 29...		H.C.L.R.
	998.	*nigra*, Linn.	March 30		H.C.L.R.
Salix	1002.	alba, Linn.	March 26	e	H.C.L.R.
	1007.	viminalis, Linn.	March 7		H.C.L.R.
	1011.	aurita, Linn.	April 4		H.C.L.R.
	1012.	caprea, Linn.	March 8	d	F.R.S.

72. CONIFRÆ.

Pinus	1029.	*sylvestris*, Linn.	April 4		F.E.K.
Taxus	1031.	*baccata*, Linn.	February 27...		F.E.K.

73. ORCHIDACEÆ.

Neottia	1036.	Nidus-avis, Rich. ...	by March 19	d	F.E.K.
Listera	1038.	ovata, Br.	April 18	bd	H.C.L.R.
Epipactis	1039.	latifolia, 'Br.' Benth.	July 12	dgk	E.C.
Orchis	1045.	Morio, Linn.	May 3	e	C.L.E.
	1046.	mascula, Linn.	April 18	d	H.C.L.R.
	1052.	latifolia, Auct.	by June 27 ...	d	E.C.
	1053.	maculata, Linn.	April 30	d	H.C.L.R.
Habenaria	1055.	bifolia, 'Br.' Benth.	by May 19	d	F.E.K.
Ophrys	1060.	apifera, Huds.	by July 4	k	E.C.

74. IRIDACEÆ.

Iris	1067.	Pseudacorus, Linn.	May 25	c	H.W.S.

75. AMARYLLIDACEÆ.

Galanthus	1073.	*nivalis*, Linn.	February 2 ...		H.C.L.R.
Leucojum	1075.	*æstivum*, Linn.	by April 30 ...		H.C.L.R.

76. LILIACEÆ.

			Date when first seen in flower.	Districts.	By whom recorded.
Lilium	1076.	*Martagon*, Linn.			F.R.S.
Hyacinthus	1093.	nonscriptus, Linn.	April 18	de	H.C.L.R.
Ruscus	1097.	*aculeatus*, Linn.			F.R.S.

77. TRILLIACEÆ.

Paris	1103.	(quadrifolia), Linn.	by April 30		H.C.L.R.

77.* DIOSCOREACEÆ.

Tamus	1104.	communis, Linn.	May 26	d	H.G.W.

79. HYDROCHARIDACEÆ.

Elodea	1107*.	*canadensis*, Linn.	July 6	c	E.C.

80. ALISMACEÆ.

Alisma	1109.	Plantago, Linn.	June 1	ce	F.R.S.
Sagittaria	1113.	sagittifolia, Linn.	June 14	be	F.R.S.
Butomus	1114.	umbellatus, Linn.	June 1	c	E.C.

81. POTOMACEÆ.

Potamogeton	1119.	pectinatus, Auct. pl.	June 23	b	R.D.
	1121.	pusillus, Linn.	July 30	b	H.C.L.R.
	1125.	perfoliatus, Linn.	June 13	b	G.H.H.
	1132.	natans, 'Linn.' Benth.	June 1	b	F.R.S.

82. LEMNACEÆ.

Lemna	1138.	minor, Linn.	June 7	all	F.R.S.
	1139.	gibba, Linn.	June 26	b	E.C.

82.* ARACEÆ.

Arum	1142.	maculatum, Linn.	March 24	e	F.R.S.

82.** TYPHACEÆ.

Sparganium	1145.	simplex, Huds.	June 18	bh	F.R.S.
	1146.	ramosum, Huds.	by June 11	bf	J.A.
Typha	1148.	angustifolia, Linn.	July 4	d	E.C.

84. JUNCACEÆ.

Juncus	1151.	conglomeratus, Linn.	June 23	d	F.R.S.
	1152.	glaucus, Sibth.	July		F.R.S.
	1157.	lamprocarpus, Ehrh.	by July 30	g	E.C.
	1162.	bufonius, Linn.	June 26	fg	E.C.
Luzula	1170.	pilosa, Willd.	by April 30	b	F.E.K.
	1172.	campestris, Willd.	March 26	k	F.E.K.

85. CYPERACEÆ.

Scirpus	1184.	lacustris, Linn.	June 1	ek	F.E.K.
	1191.	sylvaticus, Linn.	June 1	g	F.E.K.
	1192.	palustris, Linn.	by July 1	ek	F.E.K.
Eriophorum	1201.	polystachyon, Linn.	by May 31	b	H.F.

			Date when first seen in flower.	Districts.	By whom recorded.
Carex	1211.	ovalis, Good.	by July.........		F.R.S.
	1222.	vulpina, Linn..........	May 23.........	d	F.R.S.
	1228.	vulgaris, Fries.	by June	b	F.R.S.
	1247.	sylvatica, Huds.	by May 30 ...	a	F.R.S.
	1249.	Pseudo-cyperus, Linn	by July 27 ...	d	H.C.L.R.
	1250.	glauca, Scop.	May 2		H.C.L.R.
	1251.	præcox, Jacq.	April 18		H.C.L.R.
	1257.	hirta, Linn.	by May 30 ...	a	F.R.S.
	1260.	paludosa, Good.	April 19	g	F.E.K.

86. GRAMINA.

Anthoxanthum..	1271.	odoratum, Linn.	May 14.........	d	F.E.K.
Alopecurus	1278.	pratensis Linn.	June 7	d	F.R.S.
Arundo...........	1294.	Phragmites, Linn. ...	July 24.........	d	E.C.
Holcus	1313.	lanatus, Linn.	May 20.........	d	F.E.K.
Molinia...........	1319.	cærulea, Moench. ...	by July 27 ...	d	H.C.L.R.
Glyceria	1322.	fluitans, Br.	May 28.........	b	C.S.R.
Poa	1328.	annua, Linn.	March 14	d	H.C.L.R.
Briza..	1335.	media, Linn.	June 1	bdk	F.R.S.
Cynosurus	1337.	cristatus, Linn.	May 31.........	g	F.E.K.
Dactylis	1339.	glomerata, Linn.......	by March 24...	d	F.R.S.
Bromus...........	1350.	sterilis, Linn.	May 14.........		F.E.K.
Lolium	1363.	perenne, Linn.........	June 1	all	F.R.S.

87. FILICES.

Polypodiun	1374.	vulgare, Linn..........	May 1	f	F.R.S.
Polystichum ...	1383.	('aculeatum'), Roth.	May 30.........	f	F.R.S.
	1384.	angulare, Newm. ...	May 3	d	F.R.S.
Lastrea...........	1387.	Filix-mas, Presl.......	March 9	f	F.R.S.
	1391.	dilatata, Presl.	March 3	d	F.R.S.
Athyrium.........	1394.	Filix-fœmina, Roth..	by June 24 ...	d	F.R.S.
Scolopendrium ..	1402.	vulgare, Lym..........	March 9	k	F.R.S.
Pteris	1404.	aquilina, Linn.	by May 30 ...	ad	F.R.S.

90. EQUISETACEÆ.

Equisetum	1422.	arvense, Linn..........	March 24	d	H.C.L.R.
	1425.	limosum, Linn.	April 30	g	H.C.L.R.

[The dates opposite the *ferns* refer to the young fronds.]

This List is more complete than it is likely to be for any succeeding year. Only about 20 plants, and the varieties of Rosæ, Rubi, and other polymorphous genera are omitted : otherwise it might be taken as a Flora of Rugby, adapted to the London Catalogue.

Plants in brackets grow somewhat beyond the four mile radius from Rugby,

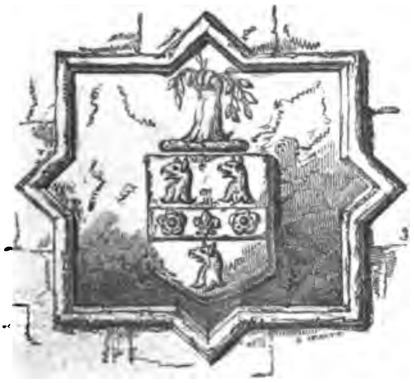
REPORT

OF

THE RUGBY SCHOOL NATURAL HISTORY SOCIETY

FOR THE YEAR

1869.



"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1870.

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

PREFACE.

THE publication of a third Report will at any rate prove that our Society has lasted three years, and is still alive.

We wish at once to apologize for two things—first for the delay in the publication of this Report, for which the President's School work is somewhat to blame, and, secondly, for the preponderance of articles by Honorary Members printed in our Report. The extracts from our Minutes shew that a full share of Papers have been read by present Rugbeians, and the Paper on 'Snakes,' by N. Masterman, (page 7) may be taken as a sample of a series which he has given us on the animals, whose habits he has himself observed. But we are obliged to select for publication those Papers which are likely to be useful in future years; hence we have printed in full Mr. Wilson's elaborate *resumé* of the geological facts on record with regard to *our* 'Gravels.' The Paper by Mr. Hutchinson on 'Spectrum Analysis' we are glad to give because it records the state of scientific knowledge up to the time at which it was read, in a branch of science the rapid development of which is a marvel of the day. To a young society any growing branch of science has an especial moral. The tale of scientific knowledge is never told, and no one need despair of some day adding an appreciable item to the amount of human knowledge. And, lastly, how could we deprive not only our own Society, but the Rugby world, of the moral which Mr. Sidgwick's Paper on 'Norway' teaches, that our holidays may be thoroughly enjoyed with eyes and ears ever open to the interests of our Society?

The extent which those Papers occupy leads us to curtail the reports of our various sections. In their place we will here briefly relate what has been done.

Finance:

Receipts.	£.	s.	d.
Balance	1	9	0
Sale of Reports	7	3	0
Compositions by Corresponding and Honorary Members	5	10	0
Subscriptions for three Terms	6	0	0
	£20	2	0
Expenses.			
Prize for Essays	1	1	0
Anastatic Press and Stamps	1	7	2
Insect Boxes	0	10	4
Printing and Lithograph of Well	23	14	0
	£26	12	6
Balance due to President	6	10	6

This state of affairs is due to two causes—(1), the difficulty of obtaining the payment of subscriptions, there being a considerable number of Members in arrear, and several Members having left the School in debt to the Society; and (2), to the great loss on the sale of the second Report.

The President has a considerable number of copies of the Reports for 1867 and 1868 on hand, which he will forward by post on receipt of stamps, and old Rugbeians can materially assist the Society in this way. The Report for 1868 (price 2s. 6d.) includes a lithograph of the section at the Rugby Waterworks and a list of the Rugby Plants adapted to the London catalogue. The Report for 1867, among other Papers, contains a list of the Rugby Lepidoptera, and has been reduced to 1s.

Future Reports may be bought at Mr. Billington's, who has generously undertaken to publish this Report at his own risk. It is to be hoped that another year our finances may be sufficiently recovered to enable the Society to distribute the Report gratuitously to Members.

Sections :

Of the Geological Section not much has lately been heard; the cause of this may be partly found in the fact that some pits most productive of fossils are not now worked, and that the manners of the workmen at New Bilton are allowed to become fierce. The head of this section is J. D. Lawe.

The Entomological and Zoological Albums are in the hands of D. A. Ogilvie and N. Masterman, to whom all notices for the calendar of this year should be sent.

What has been done by the Botanical Section will be found at page xii.

Meetings:

The Secretary sends the following satisfactory report of our Meetings:—

Number of Meetings held in 1869 . .	16·0
Average Attendance in Spring Term .	35·4
„ „ Summer „ .	38·5
„ „ Autumn „ .	44·0
Largest Attendance	74·0
Smallest „	25·0
Average „ for the whole year .	39·0

Museum:

Little has been done during the year to our Museum, but we are glad to be able to report that the possessions of the Society will next Term be transferred to a permanent home in the New Buildings; permanent, that is, so long as the Society does its work, pays its way, and keeps an orderly room. We must remember that we have always said, "If we only had a room we should do wonders!" now is the time to begin. The Society apparently accepts the room with joy: let it remember that it also accepts its responsibilities.

F. E. K.
J. M. L.
F. L.

Easter, 1870.

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians (having attended as a Visitor three of the Society's Meetings) be eligible—if in the Upper School or Sixth, as Members, if in the Middle or Lower School, as Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Treasurer, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any Office is vacant, the Committee do recommend a Member or Associate, or (for the Office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of all persons present at each Meeting; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Treasurer form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in his Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but be required to pay for the Society's Reports, for a supply of which they may pay a composition of 10s. for six years.

XIV.

That Members or Associates, on leaving the School, become Corresponding Members without election.

Of Members and Associates:

XV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XVI.

That there never be more than 20 Members, or more than 20 Associates.

XVII.

That Members and Associates pay a Subscription of 2s. 6d. per Term, and that any Member or Associate who shall at the beginning of any Term be reported by the Treasurer as not having paid his Subscription for the two last Terms be struck off the list of the Society.*

XVIII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public Meetings, and receive a copy of the Society's Report.†

---

* Subscriptions are allowed by a School Rule to be charged in the School Bills, as soon as a note has been brought to the President, signed by the boy's Tutor, to the effect that leave from home has been obtained.

† In consequence of the loss incurred on the sale of the last Report, the gratuitous supply of copies of this Report has for the present been suspended.

XIX.

That Associates have the same privileges as Members, except the right of voting at Private Meetings of the Society.

XX.

That Associates, on reaching the Upper School, do not become Members without election by the Committee.

XXI.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

Of Meetings:

XXII.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXIII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIV.

That a Report be printed once a year, or oftener if the Committee think fit.

XXV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXVI.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any name be submitted to the Committee for Membership or Association, or any vote of Suspension or Expulsion passed.

XXVII.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

LIST OF THE SOCIETY, LENT TERM, 1870.

Officers:

President: Mr. F. E. Kitchener
Secretary: N. Masterman
Treasurer: C. T. Clough
Editors: The President, J. M. Lester, and F. Lefroy
Album Keepers: Botanical, C. F. Adam
„ „ Geological, J. D. Lawe
„ „ Entomological, D. A. Ogilvie
„ „ Zoological, N. Masterman

Honorary Members:

Rev. T. N. Hutchinson, F.C.S.
Mr. F. E. Kitchener, F.L.S.
Mr. A. Sidgwick
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. J. E. Smith
Rev. C. Elsee
Dr. Farquharson
Rev. J. Robertson
Mr. Ker

Corresponding Members:

The Lord Bishop of Exeter
Dr. Helm
A. C. Bruce
E. P. Knubley, 68
P. Mahony
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H.M. Geological Survey, 67
C. L. Rothera, 68
F. W. Fison, 67
C. S. Taylor, 67
E. Cleminshaw
G. B. Longstaff, 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
J. P. Baynes
W. H. Pike
R. E. Baynes
J. M. Gordon
V. Ellis
G. A. Ogilvie
H. Wilmer

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year.

Corresponding Members—continued:

R. F. Boyd
F. R. Smith
W. Sutcliffe
E. W. Prevost
J. L. Boyson
L. Moberly
T. D. Ralli
R. Duff
H. W. Sandars
T. Rivington

Members:

J. D. Lawe
J. M. Lester
F. Lefroy
H. G. Wauton
N. Masterman
H. Powell
C. T. Clough
A. Napier
J. Armitage
R. J. Williamson
E. F. Denton
J. D. Anderson
H. A. Bull
G. H. Harris
F. R. Hodgson
T. M. Pike
C. F. Adam
J. Curry
F. C. Bayard
G. B. Darbishire
H. R. H. Bigg
A. T. Michell

Associates:

O. Leggatt
H. P. Davies
D. A. Ogilvie
M. Goodman
W. B. Lowe
H. R. Ricardo
J. E. Higgin
H. Riley
F. Gardner
H. Burrows
W. F. Gooding
A. F. Northcote
R. A. Walls
E. A. Burchardt
W. H. Cornish

BOTANICAL REPORT FOR 1869.

Above 340 dates of flowering have been recorded this year, but it is not thought necessary to print the calendar entire every year. The President has several spare copies of the Register of Plants for 1868, so that any Member can obtain a copy on application to him. It is hoped that the dates of flowering this year will be as carefully observed as in the last three years, for it is purposed soon to republish the list of plants, with the dates of all the preceding years in which observations have been made.

Considerable progress has been made in 1869 towards a complete list of the plants in each of the nine Floral districts into which our Rugby county has been divided, (see Report for 1868, p. 47). This work was however chiefly carried out by F. R. Smith, who has unfortunately left us. It has been suggested that some Botanical Member of the Society should take charge of a special district, and really work out its flora.

The principal observers in 1869, besides the President and F. R. Smith, were the Rev. C. J. Smith, E. Cleminshaw, E. H. Harris, H. P. Davies, R. Duff, and H. W. Sandars.

The dates of flowering for 1867, 1868, 1869, enable us to determine with reliable accuracy the probable dates at which some 200 flowers are likely to come into blossom. For the assistance of observers, and especially of those who do not know the scientific names, we give a list of some of the flowers likely to come out in each week of the first two Terms of our year.

Some plants may be found in blossom as soon as we meet in January, in fact they are never out of blossom; such are the Field and Ivy-leaved Veronicas, the White and Dead

Nettles, the Gorse, the Shepherd's Purse, the Chickweed, Mouse Ear Chickweed, the Dandelion and the Daisy.

The third week in February brings us the first spring flowers, the Draba or Whitlow Grass, the Hazel, the Colts-Foot, and the Figwort Ranunculus; by February 21st we have the Sweet Violet; by February 27th the first Primrose is due; by the beginning of March the Box is in blossom; and before the month is half over we have the first White Anemone, and the Dog Mercury. Between March 24th and 30th, the Hairy Bittercress, the Field Pansy, the first Charlock, and the Marsh Marigold are due. By the first week of April the naturalized Periwinkle, the Ground Ivy, the Blackthorn, the Wood Sorrel, the Wild Gooseberry, the Water Ranunculus (peltatus), the Ash, and two Poplars may be marked off: the second week brings us in order the Hairy Violet, the Field Woodrush, the Ladies' Smock, the Strawberry-leaved Potentil, the Dog Violet (sylvatica), the Cherry, and the Wild Hyacinth; in the third week we look for Arenaria trinervis, for the Teesdalia in the Lower Hillmorton Road, for Goldilocks (auricomus), the earliest of the Buttercups, for Arabis, for Jack-by-the-Hedge, and for Crosswort; and in the last week of the month for the Meadow Buttercup (acris), for the Bulbous Buttercup, for the Greater Stitchwort, for the Nonsuch, for the Field Forget-me-not, for Plantain (lanceolata), for the Cowslip, the Sycamore, and Parsley Piert (alchemilla arvensis), for Wood-ruff, and the Crab Apple.

With the first days of May we welcome the Wild Mustard, the White Lychnis, the Early Orchis (mascula), the Thyme-leaved Veronica, the earliest Carex (præcox), the Helmet Orchis, Sorrel, the Field Madder, Yellow Rocket, and common Red Clover. By May 9th we have two species of Geranium, molle and Herb Robert, Corn Salad (valerianella), the Bitter Cress, the Red Lychnis, the Holly, the Oak, and the Vernal Grass. By May 12th come out the Barberry, the Hairy Vetch, Common Ladies' Mantle, the Ragged Robin, the Marsh Stitchwort, the Meadow Saxifrage, and the Tormentil. The third week in May will see the Watercress, the Earth-nut, the Dog-rose, the Water Starwort (callitriche), and the Ox-eye Daisy, Cathartic Flax, and the Fox and Wood Sedges. By the 24th May we have Nasturtium terrestre and amphibium, Wild Mignonette, the Lesser Burnet (muricatum), Silver-weed, Valerian (divica), Sowthistle (asper), Veronica Beccabunga, and the Wild Raspberry; and before the end of the month, the Yellow Water Lily, the Cornfield Ranunculus, the Elder, the Greater Burnet, and Goose Grass. By the 4th of June we have the Field Poppy, Dutch Clover, the Cut-leaved Geranium, the Bedstraw (saxatile), the Sowthistle (oleraceus), the Doubtful Poppy (dubium), Goat's-beard, Corn Marigold, Milfoil, and Bittersweet. By June 8th are come out Vicia Cracca, the Nodding and Marsh Thistles, Dog's-tail Grass, and the Wood Stachys; and after them the Meadow Geranium, Bird's-foot Trefoil, the Spear Thistle, and the Floating Potamogeton. At this time every day in our calendar of averages is marked by fresh plants; June 10th by the Thyme-leaved Sandwort, by Veronica Anagallis, by the White Goosefoot, by the Arrowhead, and by Hypochæris; June 12th by Meadow Rue, by Dewberry, by Cornel, by Marsh Galium, and by Carduus crispus; the next few days by Lesser Spearwort, Greater Plantain, and by Ladies' Bed-straw: June 17th by Hemlock, by Black Centaurea, and Polygonum Convolvulus; June 18th by Procumbent Clover, Pilosella Hawkweed, Mountain Epilobe, and Scullcap; June 20th by Pimpernel and Rush (conglomeratus); June 22nd by St. John's-wort (pulchrum), Fool's Parsley, Honeysuckle, Self-heal; June 23rd by Lime, Meadow-sweet, and Cornfield Spurge; June 24th by St. John's-wort (dubium), Privet; June 26th by Corn Cockle, Chamomile (cotula), and Water Plantain; and the end of the month by Bird's-foot, Wild Carrot, Betony, Tetrahit, and Polygonum aviculare.

In July the number of new plants begins to fall off, but in the first ten days we welcome Common Valerian, German Cudweed, Ragwort, the Perforated and Hairy St. John's-worts; and in a few days the purple Loosestrife, Bartsia, Water Dropwort, Water Ragwort, Hairy Epilobe, and Catmint; and just before the end of the half-year the collector may wind up the Term by adding Burnet and Stonewort. The collector must not forget on his return after the holidays to get the Ivy which will then be in blossom.

It is not pretended that the above list is at all complete: it is only made up of those flowers whose dates of flowering having been observed at about the same time for the last three years, may be supposed to have been fairly accurately ascertained.

The following statistics have been made by comparing the flowering dates of flowers in 1869 with the average date in three years, which we may call the mean date.

From this it appears that—

7	February	plants	averaged	6	days before	the mean date.
6	March	„	„	2	„	„
37	April	„	nearly	1	„	„
24	May (1st half)		„	3½	„	„
21	May (2nd half)		„	1¼	„	„
34	June (1st half)		nearly	3	after	„
21	June (2nd half)		„	1½	„	„
12	July (1st half)			at the average		„
4	July (2nd half)		„	8	after	„

It will thus be seen that we had a forward Spring, an average May, a late June; the first part of July was of average forwardness, while the latter part became backward. Of course the observations on April, May, and June, are the most reliable, as they are based on a large number of flowers.

New Plants and New Localities recorded in 1869.

Ranunculus—11—aquatilis, Linn.

——pantothrix, b. trichophyllus, Chaix.

New variety; first found in this district at the old Lime Workings, near Little Lawford Mill, by E. Cleminshaw, April 27th: also to be found in the old Canal by the Cosford

Lane, where a specimen was subsequently noticed by F. R. S. and F. E. K. with floating leaves, which, according to Sowerby, has been noticed only once before.

BARBAREA—95—vulgaris, Br.
——intermedia, Bor.
New variety found by Rev. A. Bloxam.

ERODIUM—228—cicuparium, Sm.

VALERIANELLA—537—dentata, Koch.

CAMPANULA—684—hybrida, Linn.

A new locality for these three plants has been found in a field near the Lower Hillmorton Road by E. Cleminshaw.

LACTUCA—557—muralis, D. C.
New plant: entrance to Frankton Wood, E. Cleminshaw.

LINARIA pelisseriana, De C.

Found in a corn field, Upper Hillmorton Road, by E. Cleminshaw; this plant had evidently been sown with the corn; it is an Italian plant, and its nearest habitation to England is Luxembourg, where it is said to grow wild by Marchand. This is a good instance of a plant being introduced by the use of foreign corn.

OPHIOGLOSSUM—1411—vulgatum, Linn.
New plant: found at Cotesbach by R. Duff.

F. E. KITCHENER.

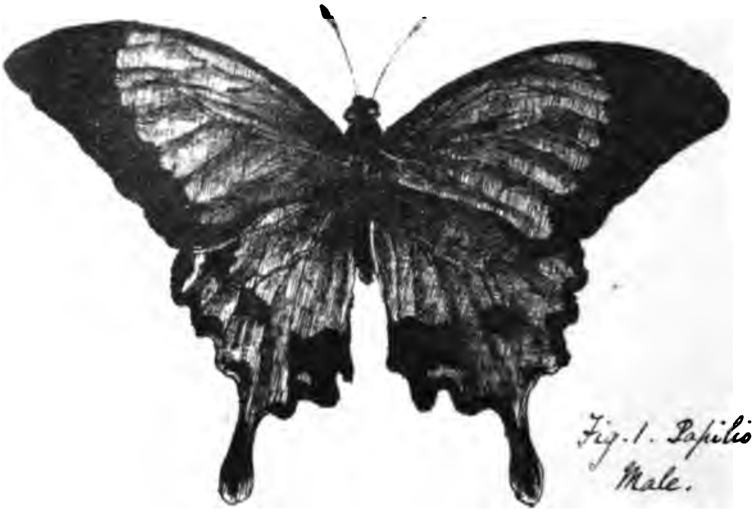


Fig. 1. Papilio Merope, Cra
Male.

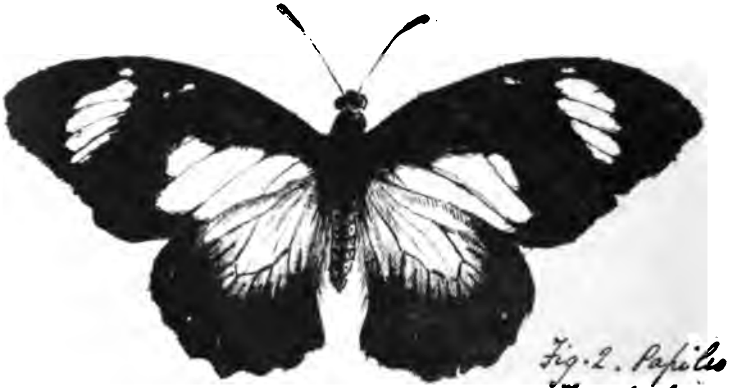


Fig. 2. Papilio Merope, Cra
Female. (P. Hippocoön, Fab.,

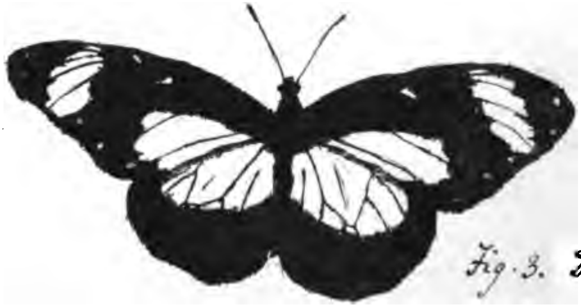


Fig. 3. Danais Niavius, L

MINUTES OF MEETINGS.

MEETING HELD JAN. 23, 1869:—*Donation:* Box of Moths and Butterflies by Mr. Longstaff. *Exhibition:* Fossils from Hillmorton by J. Armitage, Collection of Shells by Mr. Kitchener, &c.

J. Armitage read a Paper on '*The Inmates of a Rugby Pond.*'

C. T. Clough read a Paper on '*Aerial Infusoria.*'

MEETING HELD JAN. 30:—Mr. Wilson read the following Paper on '*A Remarkable Instance of Protective Mimicry among the Lepidoptera.*'

'It may be well very briefly to explain what is meant by Protective Mimicry, although it is not very long since a Paper on this subject was communicated to the Society by Mr. Sidgwick (*see Report for* 1867).

'It is well known to naturalists, and indeed to every one, that many animals resemble in colour and markings the places which they frequent, and are on this account difficult to see. For example, the grouse wonderfully resembles the heather, the woodcock the dead leaves and fern among which it is often found; the Arctic hare takes the colour of the snow fields, the lion that of the sandy plains. Naturalists have further observed that there are resemblances, still more unaccountable at first sight, between insects which really belong to very different classes. Thus the Clear wings, which are moths, are like the wasp or ichneumon fly; and several instances have been produced in which Lepidoptera of one genus are like the Lepidoptera of another genus; the external likeness being marked, while the specific character remains quite distinct.

'The specimens which I exhibit (figs. 1, 2, 3) furnish, I think, the most striking example of this imitation; and the facts which are known connected with these specimens enable us to see without difficulty its meaning and origin. I am indebted to A. Swanzy, Esq., of Lee, Kent, for the loan of these specimens, and for some facts concerning them.

'There is a certain Papilio (P. Merope), a well-marked genus, among the butterflies, which inhabits Western and Southern Africa and the island of Madagascar. The mate of this Papilio (fig. 1) is the yellow butterfly in the specimen case. The singular fact connected with it is this, that while in Madagascar the female Merope was as common as the male, and closely resembling it, in Africa the female had never been taken. It was obvious that either the female was excessively rare, which did not seem possible from the number of the males, or that it resembled some other butterfly and was constantly mistaken for it.

'The female (fig. 2) of it was first recognized as such by Mr. Trimen a short time ago, and the specimen in the case is a female Merope from Western Africa, Ashanti. A moment's inspection shews how extremely unlike the male it is. The specimen by the side is a Danais (D. Niavius, fig. 3), a genus easily distinguished from Papilio, and which is wonderfully like the female Merope.

'First, let me ask you to notice that the male and female Merope have some resemblances that are of more importance for determining the genus than colour. Compare the shapes of the bodies, the curvature of the front wings, and especially their nervures. You will observe that the nervures of the two Meropes are nearly identical, and differ wholly from the Danais. In fact, the generic distinctions of the Papilio are as clearly seen in the female as in the male; there is the crenated hinder edge of the inferior wing, though the crenations are small; the folded inner edge of the same wing so as to leave the abdomen free; the powerful superior wings; the long and recurved antennæ: so that the insect was at once classed as a Papilio, and received a separate name as P. Hippocoön; it not being suspected that it was the female of the P. Merope.

'Now look at the external resemblance of the female Merope to the Danais. The colour and markings are so precisely the same that a careless observer would at once pronounce them to be the same or very nearly allied species.

'But the whole of the facts are not yet put before you. The Papilio Merope has the range before given, but no species of Danais has so extensive a range. In different regions of Southern and Western Africa are four distinct species of Danais, (the specimen exhibited being one of the four which inhabits the Gold Coast), and in each region the female Merope *resembles the local Danais.* It is impossible to overestimate the importance of this fact. If it was 100 to 1 against such a resemblance between the female Merope and one local Danais being the result of chance, it is more than 100,000,000 to 1* against the present state of things being the work of chance; that is, that in four distinct regions the female Merope should resemble the four local Danaides.

'What is the use of this resemblance? What is its meaning? To answer these questions requires an additional bit of entomological information. You must know that the Papilios are good to eat, not only for birds, but even for men. In Australia, during November, December and January, the Papilios are caught (by being smoked) by the natives and eaten: but the Danais is unfit for food. Hence in the neighbourhood of birds' nests the wings of Papilio are frequently found, which have been rejected while the body has been eaten, and the wings of Danais never.

'It appears then that the use of the resemblance to the female Merope is that she is mistaken by the birds for a

---

* 104,060,400 to 1.

Danais, which they know to be unfit to eat, and thus she escapes death. This is what is called Protective Mimicry. When we consider these facts we must either regard them as the immediate result of God's will, and say that He created four females to the P. Merope like four species of Danais, and causes them still to confine themselves to the regions inhabited by these Danaids respectively; or we must look for some ordinary and invariable laws by which this resemblance has been produced, and this distribution is still preserved. Absolutely the whole of the analogies of science point to the latter as the alternative. Nothing that we see is as it was created, but is due to the long continued operations of certain laws on the beings created long ago.

'The problem of Protective Mimicry was first stated and solved by Mr. Wallace and Mr. Bates, the well-known Naturalists of the Chinese seas and of the basin of the Amazons; and is a corollary to the great theory of Darwin. This is the solution of the problem.

'All species vary somewhat from their progenitors; and among the varying descendants some only can live; the multitude of beings produced being infinitely in excess of what can survive. Not chance, but some reason, will decide which survive. Those will survive who have some advantage in the struggle for existence. The cleverest fox, the swiftest deer, the sandiest coloured lion, the most tuneful thrush, all have the advantage over the rest. And so among the Lepidoptera; those survive which escape the keen eyes of birds by their resemblance to the stones on which they sit, and the leaves among which they fly; and to this list Mr. Wallace has added many which escape destruction by their resemblance to others which are dreaded or disliked. There is then, and has been for ages past, a constant selection made among the female Meropes, the survivors being those which are in each locality most like the local Danaids which the birds know to be uneatable; they only survive, and transmit this similarity to their posterity; and in this sense the female Merope is said to 'mimic' the Danaid.

'In conclusion, I think the thanks of the Society are due to Mr. Swanzy for his kindness in lending us these extremely rare and instructive specimens.'

[NOTE.—The interest of Mr. Wilson's Paper was much increased by the presence in the room of actual specimens. We have done our best to make up the want of actual specimens by pictures.

Photographs were taken of the actual specimens by Mr. Edmunds, of Rugby, and from the photographs drawings were prepared by J. C. Anderson.

It may be convenient to refer our Society for further details on this subject to the Paper by Mr. Trimen, 'On Mimetic Analogies among African Butterflies,' in the Linnean Society's Transactions, vol. xxvi. part 3, (which the President will be happy to lend to Members); to Mr. Darwin's 'Origin of Species,' 4th edition, p. 48; and more especially to the eminently readable book by Mr. Wallace on 'The Malay Archipelago,' pp. 128—133, and to the article by Mr. Wallace on 'Mimicry and other Protective Resemblances among Animals,' in the Society's Library.—F. E. K.]

Some conversation followed on the subject of this Paper.

Mr. Lester enquired whether any reason could be assigned for the selection taking place only among the females.

Mr. Wilson replied that this was the best question that could be asked, as the reply to it brought out in the strongest light the conditions under which alone permanent variations would be produced. As far as he could see the answer, it was this. For the continuance of the species it was only necessary for the males to live for a few days, while the females must live longer. Hence among the males no selection, or an extremely incomplete one, was made of those which should—not survive—but have posterity; whereas the selection of the females was much more complete. On the supposition then that peculiar males transfer their peculiarity to their male descendants alone, and the same with females—which is justified by a wide range of facts—we can see why the females alone have so widely diverged from the males, the diverging females alone being selected. As regards the physiological law assumed above he had no remarks to make, except that the problem was precisely the same as that relating to all animals in which the male and female greatly differ, as in pheasants, for example, in which the difference is produced probably in the same way.

Mr. Sidgwick adduced in illustration of the Paper the remarkably similar relation of the Heliconidæ and Leptalides in South America.

Mr. Kitchener reminded the Society that they had done nothing yet in the way of following out Mr. Wallace's suggestions to Mr. Selous to notice what caterpillars were eaten by birds.

Mr. Wilson then exhibited a large spider, probably Phrynus Lunatus, in which the front tarsi were developed into antennæ 6 inches long, and the palpi were metamorphosed into a pair of very strong jointed arms armed with claws like a lobster.

F. R. Smith made some remarks on the natural classification and on the habits of spiders.

Election: Mr. W. C. Eyton, Corresponding Member.

MEETING HELD FEB. 20:—*Donations:* The 2nd volume of the Palæontologica Indica, and vol. 1, part 3, of the Records of the Geological Survey of India, presented by Dr. Oldham, Superintendent of the Survey, through Mr. J. M. Wilson. Also, a collection of Ferns from New Zealand, presented by D. Reid, Otago, New Zealand, as an old pupil of Mr. F. Simmons, O.R. *Exhibitions:* Tailor's

Bird's Nest from Bombay, by J. M. Lester; Pea with 3 cotyledons, by G. Darbishire; impressions of Ferns from Newcastle Mines, Hunter River, Australia, by F. C. Bayard, &c.; a large block of Lias Limestone from a glacial deposit not previously reported in the Midland Railway cutting, between Brownsover and Cosford, on the far side of the Canal, by Mr. J. M. Wilson, who pointed out the chief points of interest in this discovery; a splendid collection of Minerals to illustrate the Mica Family, by Rev. T. N. Hutchinson.

N. Masterman read a Paper on '*English Snakes and the Blind-worm.*'

'Amongst English reptiles we have only three real snakes, the Viper, or Adder, which is poisonous, and the Ringed or Grass Snake, and the very rare Smooth Snake, which are both harmless: the Slow-worm, or Blind-worm, which looks so like a snake, being really a lizard.

'There are several characteristics which are common to all three. Such, for instance, as the changing of skins at certain periods: the reason for the change being similar to that which affects caterpillars, namely, that their skin not being expansive and porous like that of animals, they grow too big for it. This, however, is effected in rather different ways. The snakes begin at the back of the neck, and, drawing themselves out of it, turn the skin entirely inside out in the process. In the Blind-worm it peels off anyhow; in all cases the change is so complete that even the skin of the eyes comes off.

'Again, all three can swim well and rapidly, and in the same peculiar manner, by gliding very rapidly in long curves, and seeming to be completely on the surface the whole time.

'It is a question whether or not our snakes use fascination as a means of capturing their prey: it is certain that a fat frog looks very uncomfortable when a snake has its eyes fixed on him, preparatory to eating him.

'The snakes hibernate in clusters together for the sake of warmth, though probably the Blind-worm does not.

'THE VIPER.

'It is impossible for any one who has seen a Viper after previous acquaintance with the Grass Snake not to be at once struck with their great difference, both in appearance and in habits. On looking at a Viper, the first thing which catches the eye at once is the broad black zigzag down the back: this never varies whatever be the ground colour, which latter varies from olive-green to dark chocolate, according to the health and vigour of the reptile. A Green Snake will lie basking on a bank till you may come within a few feet of him, trusting to his colour and stillness to hide him; but the moment a Viper hears the sound of a footstep, or sees anyone approaching, he is off immediately, winding in and out of the grass or heather so rapidly that he is out of sight in a very few moments.

'The Adder is a general object of hatred. Nature has armed him with very powerful weapons, but he never uses them unless trodden upon when sleeping or provoked.

'In size the largest British Vipers have never exceeded 3½ft. or 4ft., and it is rare to find them above 2ft. In England they seldom exceed 1ft., but in Scotland are much larger. In shape the head and neck are exactly like a spade in a pack of cards (as Wood remarks), the head widening out of the neck in exactly the same manner. The body becomes very thick in the middle and narrows very abruptly towards the tail; very differently from that of a Grass Snake, which tapers off gradually. Adders always frequent hot and dry places, especially if the soil be sandy. On a chalky soil they are seldom found.

'They feed on mice, lizards, beetles, and such small fry, which are swallowed whole, and the reptiles are then to be seen with a large knob in their bodies for some time. I was told of one who cut a very curious figure with three such knobs in his body, consisting of mice in different stages of decomposition—the furthest being very far gone, the second better, and the first only very lately killed!

'The poison is probably stronger in hot sultry weather and is very much influenced by the state of health and activity of the reptile. It is also capable of rapid exhaustion, as has been proved in the case of a Rattle Snake, which killed its first victim in about a minute, its second in about ten minutes, while an hour or more elapsed before the death of a third.

'There are only two poison-fangs, each set in the upper jaw, and furnished with a separate bag of poison with which it is connected by a tube: there are also other small teeth behind, ready to supply the loss of either of these. On examining the mouth of a dead Viper one looks for the teeth: but they are nowhere to be seen. All that is visible is a little knob of skin hanging down in the place of each. But insert a pin or small stick behind either of these, and draw it forward, and out starts a tiny little tooth finer than the point of a needle.

'These are the terrible weapons which will kill a man if remedies are not soon applied! The Viper usually coils itself up to strike, shooting out like a watch-spring,—as Scott says, "Like adder darting from her coil." The arrangement of the teeth is such that when not in use they lie backwards in their envelope of skin, but when the Adder starts up and opens its mouth wide they are drawn up stiffly. I have been told that if you hold the stock of a gun to an enraged Adder, it will strike at it, and the minute drops of poison can be discovered on the polished wood where the teeth struck it.

'The Viper is ovoviviparous, *i.e.*, produces her young alive, though previous to birth they are wrapped in a sort of jelly corresponding to an egg: they are from ten to twelve in number. The question whether or not the Viper swallows its young when frightened has been very much considered of late.

'Many stories are given by witnesses, mostly in this strain: that a man saw an Adder and her young, and on being frightened she hissed (this would seem to be as a call to them), and that the young hastened to crawl into her open mouth. I have read one story in which the young tried to do this, but were stopped all but one by a mouse which had been lately swallowed. Now those who deny the possibility of the young going into the Viper's stomach, say that they would be destroyed by the gastric juice; but it is well known that frogs have been removed after some minutes in perfect health and activity from the stomach of a Grass Snake, and I cannot see why young Adders may not do the same, as the parent disgorges them at once on reaching a place of safety. I will conclude with an account of a Viper-hunt I enjoyed last Midsummer when staying with a friend in the North of Scotland.

'There was a great deal of heath in the place they most frequented, and thither we set out on a very hot morning, at about 12 o'clock, armed with forked sticks sharpened at their points. My friend led the way, and we had not gone far, being about two yards apart, when a very fine dark-coloured Adder glided across between us, and just in front of me, very rapidly indeed, among the long heather. However, I watched him under a very small bush lying on the heather, and we came to the attack, I drawing aside the bush while my companion attempted to pin the Adder down with his stick. But in a moment it had glided under a similar prostrate bush a few yards off: and on removing this we found it had got into a small recess among some stones, just big enough for a rabbit to hide in, and there we saw the magnificent great snake gliding among the stones and trying to hide himself. We teased him in there with the end of a stick, and it was most beautiful to see his angry head darting repeatedly at the stick, as he bit it furiously. By moving the stick he was soon drawn a few inches out of his hole, and we then pinned him down at the neck and tail.

'He was now powerless, and with a bootlace tied tightly round his neck, we bore him home in triumph. He was thus left for an hour or so while luncheon was going on, and after this, on loosening our victim, he began to move slowly, to open his mouth, and if we had not soon tied him up, would have been dangerous again.

'However, he soon died after this, and was safely pickled in spirits, and I hope soon to exhibit him to the Society: he was the finest Adder I have ever seen, being 26 inches long, and very dark-coloured.

'THE GRASS SNAKE.

'The differences remarkable between this and the last-mentioned are principally these: firstly, it is harmless; secondly, it lays eggs; thirdly, it is fond of marshy ground, and enjoys the water—diving well. There are also other minor distinctions, such as the large plates on the head, those of the Viper being small, &c.

'In size the Green Snake reaches 4ft., though 2½ft. or 3ft. are the usual sizes. The colour varies, though not so much as in the Viper.

'Their food consists principally of frogs, besides mice and birds' eggs. A small frog has been known to jump out of the mouth of a large snake after being swallowed.

'When frightened, the Grass Snake will take at once to the water if it be near, and, plunging in its head, go straight to the bottom, where it will remain for a very long time without coming up for air. It is said also to be such a good swimmer, as to catch newts in their own element.

'Having no teeth of any size, the only defence of the Grass Snake is a most horribly strong scent it emits when angry.

'The eggs are about the size of a sparrow's, from 16 to 20 in number, tough and soft like bags of pale yellow jelly. They are attached together in no order by a glutinous substance, which at first is moist, so that they stick together wherever they touch, and which afterwards hardens. They are usually laid in dung-heaps or other warm places.

'The skin is often to be found in places where there is tangled grass. I found a fine one in the wet tangled grass on the edge of a small pond near Coombe, and a few yards off was the owner, looking very dark in colour, and having evidently very lately undergone the change.

‘THE SMOOTH SNAKE.

‘The Smooth Snake abounds on the Continent, and has been found two or three times in England: it may, perhaps, be called a British snake.

‘It is quite harmless, the size being up to 2ft., and the colour light-brown with many black spots on the back and sides.

‘It feeds on small creatures and is ovoviviparous.

‘Mr. Buckland once caught one in the New Forest, which he has described: I have also read an account of a fight between a tame one and a Blind-worm, in which the Smooth Snake ate the latter.

‘THE BLIND-WORM.

‘The Blind-worm, which looks so like a snake as often to be killed for one, is really a lizard, and possesses the rudiments of lizard's legs under its skin, besides having the moveable eyelids of the latter.

‘It differs also widely from a snake, in its tongue which is broad and only slightly forked at the tip, instead of narrow and much forked.

‘Also, the skin is very different. Snakes, having no legs, are furnished with long scales like beads on their under surface, which are connected with the ribs, and by moving which they progress. Lizards run by means of their legs. But the poor Blind-worm, having his legs inside his skin, and being unfurnished with the plates of the snake, can only progress by sheer wriggling. This is probably the reason for the natural slowness of its habits: it is fond of lying on a bank, dozing in the sun, and will rather pretend to be dead than seek to escape by flight.

‘But on long enough grass it is wonderful at what a pace it will go if frightened, wriggling much more than a snake, which goes in long curves 〰〰〰〰. It is curious that though the Green Snake is so often made a pet of, the Slow-worm is very seldom, in spite of his smaller size and freedom from the horrible odour of the snake: it is probably because he is so often taken for an Adder on account of his colour. However this may be, I have had two very interesting pet Slow-worms. The most curious point about them was their different colour, the first being bright copper-colour, the second, slate-blue. On referring to the Encyclopedia Brittanica, I found that there is a variety called the Aberdeenshire Slow-worm; my first, which was captured in Aberdeen, was apparently of this variety.

'My first was about 15 inches long, and at first I kept it in a box covered with muslin: after about three days it got very tame, and I frequently carried it in my pocket. If laid upon the grass, it would insinuate its head among the blades till almost out of sight, and so crawl slowly away. It did not seem to mind being tied in knots and pulled about, but if it felt uncomfortable would bite my hand as hard as it could.

'Owing to the heat of the weather I could not find any slugs for it sometimes, but it would drink water eagerly, lapping it up with its tongue, and licking up sand whenever it could. It could swim very well, but seemed to dislike the water, always making straight for land. At last I procured some slugs, and fed it at first by opening its mouth and inserting one end of the slug, when it soon drew in the whole, at large gulps. After a short time it would take them itself when offered. In this way it would take seven or eight small ones, or two or three large ones. It could manage a slug as thick as its own body, and nearly 2in. long, though with some difficulty, having to take in and eject most of it once or twice before it could squash it sufficiently. It was very fond of warmth, and would lie curled up in my pocket for any time without trying to get out. Eventually it was lost by being dropped by mistake on a moor.

'My second pet I found in Wiltshire on the grass in a field: at first it tried to make off, but when I grasped at it, lay quite still, pretending to be dead. It was only in my possession a few days before I lost it, through its having been left by mistake near an open window. They were both very beautiful little pets, and had a curious trick of winking their eyes at one, which looked very ridiculous.

'The tail of the Blind-worm is known to be very brittle, whence its name of *fragilis*: a smart tap with a stick being quite sufficient to snap it off. The reptile is also said to be able to throw it off at will. Immediately after the separation the tail becomes very lively, jumping up and down and writhing on the ground, so that while the spectator is lost in astonishment at its movements, the owner has time to make his escape. This tail is very useful in another way; it is wonderfully prehensile, and if any object be touched against one side of it, will immediately curl round it: the Slow-worm makes great use of it in clinging to grass, &c. Certainly none of our snakes possess this remarkable quality; they cling by erecting their scales, while the Slow-worm does so by winding round and squeezing things with very great power considering its size.'

[NOTE.—Since I last had the pleasure of addressing the Society on the subject of Snakes, I have made a nearer acquaintance with one of their number, the Green Snake, and think it may not be out of place to mention a few observations I have made on it.

On Sunday, April 11th, we caught a small Green Snake, about 2ft. long, on which—as is always the case—it gave vent to that peculiar odour with which they are gifted, and which proceeds from a liquid substance apparently emitted from under each scale over the body. However, I was prepared for this and carried him in a handkerchief, and put him in a bandbox, with a quantity of grass and hay, in which he curled himself up.

At first he was very shy, trying to escape whenever he could, but after a few days he got quite tame, and never after I caught him troubled us again with his scent.

After a day or two I took him out of the grass and played with him there; then I put him into the slender boughs of a large beech tree, and it was most beautiful to see him glide along, winding in and out amongst the thinnest twigs, and then hanging from them in a graceful coil, and dropping about a yard to the grass. While on the subject of snakes' climbing powers, I may mention that I saw a very large and yellow-coloured one lying curled up comfortably on the lower branch of a hawthorn near the bank of the old Canal, near Barby, about a foot from the ground. He lay watching us for a minute or so, lolling his tongue out at full length, and not seeming at all inclined to move until I moved my head, and he glided quietly off.

Amongst other things I noticed about him, he has a very graceful action when he crawls on the grass, holding his head two or three inches above the ground.

He has eaten very little since I had him: one day I put a small yellow newt into his waterpan, and turning out the hay next day it was nowhere to be found; so I concluded he had eaten that. Another time a blackbird's egg was offered to him after the small end had been broken off, and he plunged his head in and sucked greedily; this was a hard set egg, and he did not seem to care for a fresh one. I always gave him a pan of water in his box, and kept the whole inside the dresser in the kitchen, so that he might be warm enough. If he found the heat too great, he would curl up in the waterpan and so keep cool.

He was very fond of warmth, and, like the Slow-worms I kept, would creep gladly into my pocket and remain there for any length of time. One peculiarity I do not remember to have seen related elsewhere—he never hisses except when frightened or vexed.

When I brought him here with me with the intention of exhibiting him to the Natural History Society, I kept him in a mouse cage with a nest of wool in the nest-box in which he slept, but if the cage was put in the sun it was wonderful to see how soon his head appeared at the entrance, and he crawled out to bask in the warmth. The oddest part of his history is yet to be told. Last Monday, when I was in at work from 5¼ to 6, he contrived to escape through the bars of his cage, knocking it down from the window to the floor in the process. The obvious probability was that he had gone out of the window. However, I searched in the study, and then went into the Close to look for him there. He was nowhere to be seen—besides which I found there were a lot of small gratings and holes into which he could and probably would creep —so I gave him up; but knowing his fondness for basking in the sun, I came in the forenoon next day, in case it should have tempted him out. Still, however, there were no traces of him, and I gave up all hopes of seeing him again. This morning I was looking for a paper in my study, and it occurred to me, "How very odd it would be if the snake were to turn up in some out-of-the-way place." The next moment the idea had passed out of my mind, but by a connection of circumstances which perhaps Eyton could explain to you, I went to a book-shelf and raised the flap in search of my paper. There was the old fellow curled up comfortably on the top of the books, five days after I had lost him.

And, after having recounted his history, I now produce him to speak for himself to those who are not frightened by his appearance. —J. M.]

J. M. Lester read a Paper on '*Glacial Markings*,' observed by him in the neighbourhood of Conway, North Wales.

MEETING HELD MARCH 6:—*Presentations:* Report of the Marlborough Natural History Society for 1868; Science Gossip for March, 1869. *Exhibitions:* A Stereoscopic View of the Moon, by Mr. J. M. Wilson.

D. A. Ogilvie then read a Paper on '*Self Defence in Nature.*'

Mr. J. M. Wilson then read a portion of the following Paper:—

'ON THE DRIFTS AND GRAVELS AND ALLUVIAL SOILS OF RUGBY AND ITS NEIGHBOURHOOD.

'It is very desirable that on this subject accurate information should be accumulated and preserved in a form accessible to all Members of the Society. The question of the origin of the gravels is too complicated to be settled in an offhand way; and this Society is able to do good service if it will in the course of the next few years publish carefully verified facts about the gravels, and thus enable others, who from experience elsewhere are better able to make general theories, to combine our information with their own.

'In the present Paper, therefore, I shall confine myself to the bare statement of facts, for which I myself am responsible; I have either observed them myself, or obtained them on the authority of builders and well-sinkers, in whose knowledge I can put confidence.

'There is a plateau of irregular shape, of which the southern edge is well defined, on which the villages of Bourton, Thurlaston, Dunchurch and Hillmorton are placed. From this line, which faces S.S.E., the eye ranges over the wide valley of Birdingbury, Granborough and Willoughby to the Shuckburgh hills. This valley is drained by the Leam, one branch of which is Rainsbrook, which rises near Barby and Kilsby, in the high land on the opposite side of the valley, and flows under the escarpment spoken of from beneath Hillmorton till it falls into the Leam, south of Dunchurch. The height of the plateau above the level of the valley is about 120 feet. The plateau has a slight slope towards the N.N.W. The heights of points nearly equidistant along the Hillmorton, Dunchurch and Avenue Road are in succession 403, 400, 400, 400, 392, 375, 370, indicating a slope westward; while the heights 396, 382, 378, 355 on the Dunchurch, Rugby and Clifton Road, indicate a still more decided slope towards the N. The Southern edge, it has been observed, of this plateau, is well defined; the North-Eastern edge, which forms the Southern slope of the Avon valley, is less well marked; and is broken by a succession of lateral valleys which contain tributaries to the Avon. The village of Low Morton occupies such a lateral valley; another is crossed by the Low Morton Road, about half a mile from Low Morton: and an important valley is crossed by the Lawford Road at the Victoria Works, and by the Bilton Road halfway to Bilton; of which one branch runs up immediately to the South of Rugby, and is crossed by the Dunchurch and Barby Roads, and is shortly afterwards lost; another is crossed by the Dunchurch Road, on the Rugby side of the Dunchurch Toll-gate, and is merged in the plateau at the distance of a few fields.

'I propose to confine myself in the first part of the present Paper to the drifts on this plateau and on its slopes.

'At Bourton the soil is generally gravel and sand, like that at Rugby, 12 or 13 feet thick, reposing on clay. In some places the clay is nearer the surface. At about 30 feet deep the limestone rock is reached. This, as is pretty obvious from an inspection of the map, and a knowledge of the general strike of the strata, is the continuation of the Newbold limestone, and it does in fact come to the surface at the foot of the hill at Draycote, immediately below Bourton. One well at Bourton, Mr. Ekins', is 90 feet deep, 60 feet of it being in the rock.

'The same general character continues along the escarpment to Thurlaston, which is almost exclusively on gravel of the same or greater thickness. In two places, however, I am told there are deep wells of 50 feet, which of course indicates that the depth of the gravel there is insufficient to supply the surface with water. At Thurlaston the limestone rock is not reached, and only some thin bands of it passed through which lie interspersed in the clay. This part of the lias corresponds to that part of the Artesian well section which is altogether above the group of the Newbold limestones.

'At Dunchurch the nature of the surface deposits is precisely the same. I have not been able to hear of any deep wells. The gravel and sand is generally about 13 feet deep.

'At Mr. Harrison's house, on the brow near Bilton Grange, there are three wells, two in gravel of 13 and 8 feet, and one of 30 feet. No clay with chalk pebbles has been noticed there.

'At Bilton Grange the depth of the gravel varies much from 6 feet onwards, and all the way to Hillmorton the same remark is true. On the whole it deepens towards Hillmorton, but an inspection of the ponds shews that there are many spots where the clay nears the surface.

'There is considerable uncertainty in my mind about the nature of this underlying clay; whether it is true lias or a reformation of it containing pebbles. As far as I can learn it is the latter, but this needs verification, and any one who can bring proofs of the nature of the clay that underlie the gravel on the brow from Hillmorton to Dunchurch, and Thurlaston and Bourton, will do good service.

'At Hillmorton we come upon the most interesting and varied spot in the whole neighbourhood. The gravel along the upper road averages 14 or 15 feet, thinning out on the slopes on all sides. At the toll-gate leading to Kilsby it is 8 feet. At Mr. Darnell's, which is at the head of the little lateral valley leading to Low Morton, it is 13 feet. At the Hillmorton clay pits it can be seen to thin out down the slope of the hill, from 6 to 3 feet or less. Below the gravel, in sinking Mr. Darnell's well, was a stiff sandy soil, wet, with streaks of white and red clay; then a stiff blue clay containing chalk pebbles, 3 or 4 feet, and finally blue clay containing nodules of limestone. The largest of the chalk pebbles was about 1½ inch round. The well was sunk 42 feet, and the boring contained 25 feet; the thickest limestone passed through was 4 inches in the well, and 6 inches in the boring. These facts rest on the authority of Mr. Darnell, and Mr. Cooper, the well-sinker he employed.

'The ground slopes on all sides down to the narrow valley in which Low Morton stands: the street that leads to Hillmorton occupies the whole width of the valley. The gravel thins out down the slope, and entirely disappears just above the lower village, where the surface soil is seen at the new clay works, on the right of the road as you descend, to rest directly on undisturbed lias clay. On the sides of the valley there are very large accumulations of sand, which form perhaps the most striking feature in this neighbourhood.

'On the left hand side of the valley is a large sand pit, with a clay pit just above it. In the upper pit flinty drift is seen to overlie interstratified sand and gravel beds to a depth of about 10 feet. The lower sands are not distinguishable in any way from the sand of the sand pit with which it is evidently, in fact continuous. I observed in February, 1869, a small fault, or system of faults in the sand. See first figure. I made a further excavation below the fault, and ascertained that it went down into the clay which is seen to underlie the upthrow. I was not able to discover the flinty and chalk pebbles in that clay which were found by Mr. Lloyd.

'Seams of clay of a fine greasy character, and generally yellowish, are found in the upper part of the sand pit, and correspond to the clay below the fault in character. The sand has a thickness of at least 47 feet, and is thrown against a remarkably steep face of lias clay. This lies at an angle of not less than 45° to the horizon, and is a very remarkable feature. The clay higher up the valley than the sand pit, where now (March, 1869) the workmen are excavating, is covered with a reformed clay containing pebbles, but as far as I have seen, no chalk. The sand pit forms an amphitheatre of 47 feet in height. It is a sugary dirty sand, containing about 5 per cent. of chalk and sesquioxide of iron, according to an analysis made by Mr. W. H. Pike, in the Laboratory. The exact result was 94.988 of silica and 5.012 of soluble matter. The sand is stratified, and contains layers of black carbonaceous matter resembling coal. It contains a few small pebbles of flint and quartz, and in the streaks of fine clay are nodules which contain some lime, of uncertain origin. In the clay seams I have found several specimens of rolled *gryphæa incurva.* The sand skirts the whole northern edge of the plateau before spoken of, and is shewn at the cutting on the Rugby and Low Morton Road. It reaches as far as the Rugby side of the next valley running up into the plateau, and extends about half-way up the slope, and there it thins out and the clay is close to the surface. The long promontories of raised land that run out into the valley of the Avon are of sand of the same character. To return to Low Morton, we next observe that the valley is covered in its lower part with sand, and the East as well as the West side of the valley has large sand banks. It is exposed at Mr. Chamberlain's, the builder's, on the South side of the principal street, and at other places, and is there seen to be covered with clean flinty gravel. It is again seen in the road from Low Morton to Hillmorton, and on a very grand scale in the ballast pits. This sand resembles in every respect the sand at Hillmorton, except that it is perhaps a little freer from clay, and cleaner. It has been largely excavated for ballast for the London and North-Western Railway, the depth reached being over 50 feet, the extent being several acres. This sand pit contains some remarkable phenomena. The cliff to the West exposes a fine section of gravel overlying sand. The conformation of the surface is very peculiar, and puzzled me completely till I obtained an explanation from Mr. Lucas, who had the contract for the ballast. *At *a, b* is the cliff of gravel before spoken of, *c, d* is a terrace, of considerable breadth, below the surface of the fields behind, from which the gravel has been removed, apparently with the intention of working the sands below. The middle of the pit, *e*, *f*, is occupied with numberless hills of gravel. The history is this; the gravel was removed in order to get at the sand, but there is no sand there. The edge of the terrace is the same steep cliff of lias clay which runs continuously up to Hillmorton. So steep is it that the sand slid down it in mass and upset the waggons. The part from *a* to *b* is not worked, because it cannot be got at without widening the bridge, there not being sufficient room to turn. Over the sand, where it is now removed, lay in some places masses of reformed clay containing pebbles. Some of these are still to be seen. I have found lias, oolite and chalk, and many flints and quartz pebbles there, some well striated. There is one heap of clay there which was brought from Blisworth, of which the collector of specimens must beware. Also there is much syenite lying near the rails, for here were prepared the paving stones for the London and North-Western yard at Kilburn. Much caution is therefore necessary in recording specimens as found at the ballast pits. There is one small piece of bone,* which I exhibit, which I am unable to determine, which I found on the surface of the sand, and among pebbles. At the southern extremity of this pit is some extremely clean sand, which is now not exposed. The sand exhibits almost everywhere diagonal stratification, as if it had been deposited under a variety of currents. It contains occasional layers of clay, also of a black carbonaceous matter, and small pebbles of flint, quartzite, and chalk.† Several pieces of oolite are found lying on the sand.

---

* This refers to a diagram exhibited when the Paper was read.

'To return to Low Morton, it is discovered by the sinking wells that the sand extends to a considerable depth. At many of the houses the wells are 30 and 40 feet deep in sand and quick-sand resting on clay. The water in them is inexhaustible. The whole slope on which the village stands appears to be of this nature. To the contents of the bed of the valley we shall recur presently.

---

* This I afterwards found to be not a bone at all, but a cast of a portion of an air chamber of a nautilus, the rounded portion and projections closely resembling the articulations of a bone! It deceived every one who saw it.

† Mr. Searles Wood, junr., is said to have found ostra edulis in this pit.

'Continuing the slope of the plateau towards Rugby we find still deep sand for half a mile. At Mr. Vann's, near Hillmorton, the well passed through a few feet of gravel, and then 40 feet of soft boggy clay, not lias, after which water was reached.

'At Abbot's the same was the case, gravel, then clay, and then sand, which yielded water which rose to 12 feet from the surface. The total depth was 50 feet.

'In the farms between Rugby and Low Morton, and between the Cemetery and the Railway, the well-sinker reports to me that there is generally 13 feet of gravel, (which I verified when the Cemetery was enclosed), lying on a clayey sand. At the slope of the hill, on the way towards Clifton, the London and North-Western Railway offers a magnificent section through this deposit. The cutting is not less than 60 feet in depth and three-quarters of a mile long: and exposes a reformation of lias clay, containing scratched stones. I have put in the School collection well striated blocks of liassic limestone, and chalk and some flints, and a curious group of serpulæ. The clay is wholly unstratified, and very soft, and liable to slip under rain. Among the rocks in it is a large block of very red syenite. The whole depth of the cutting, except a few feet of gravel at the top, appears to be of the same nature.

'The deposit disappears before we come to the station, which rests on lias. Higher up the slope of the hill is found a bed of sand on the lias, which extends up to the Gas Works, where the gravel begins, and where it has a thickness of 13 feet. I do not know the relative position of this sand and gravel.

'We now come to Rugby itself, which is on an arm of the plateau at first described, and from which the ground slopes decidedly in three directions, S. W. and N. It may be taken probably as a fair sample of the plateau, and well illustrates the singular varieties in the distribution of sand and gravel.

'Along the Hillmorton Road there is gravel, varying in depth from 7 to 13 feet, generally mixed with sand. The School Close is of the same nature: so also the eastern side of the town, down to the George Hotel, where, however, the gravel is thin, and the water is obtained from a well 60 feet deep, reaching the rock. At the Rectory the gravel is 14 feet thick; at the Lawrence Sheriff's Arms 14 feet. At Mr. Caldecott's, on the slope towards the Station the gravel is thinner. Towards the West of the town we meet with sand. Billington's is on sand 23 feet thick; St. Matthew's Church and Mr. Bloxam's, sand 20 feet thick: and generally on the South side of the Bilton Road it is sand, as at Mr. Pennington's, Colonel Fryer's, Mr. Campbell's, Mr. Atty's; and also at the late Mrs. Rhoades', on the North. But at Mr. Furness's, and other houses on the North, there is gravel and clay. To the left of the Newbold Road, beyond Mr. Buchanan's house, the hill is capped with deep sand, the lower part of which is a perfect quick-sand. When a sewer was recently made there, the sand had to be shored up with planks, and it was found impossible or unsafe to remove them, and they are all buried in the sand.

'Continuing on the edge of the plateau we meet with a sand pit on the footpath to Newbold. Much of the sand is now removed from it. There used to be exposed a face of sand of precisely the same character as that at Hillmorton: sugary, dirty, and stratified partially, containing very few if any pebbles, and marked with a few black seams. It was covered by a foot or so of the usual flinty drift. Lower down the slope it was thinner, and the gravel reposes on undisturbed lias clay. There appears, however, to be some reformed clay and scratched stones, as Alexander and Taylor and I have found on several occasions stones, apparently glaciated, lying on the surface in this pit. We were never able to discover it *in situ*. The sand seems here to graduate into the ordinary drift.

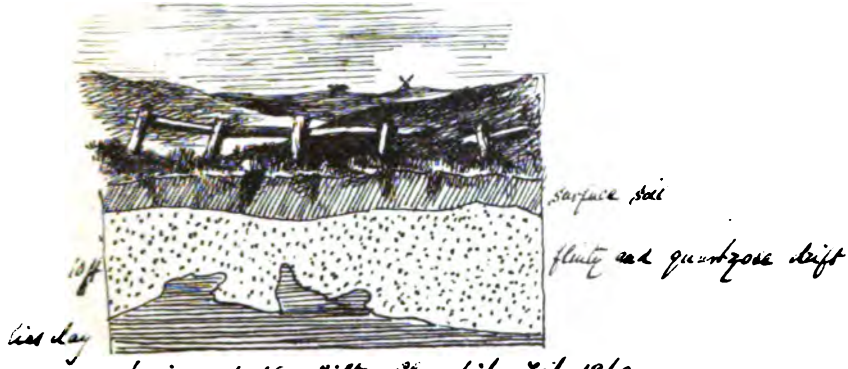
'On the other footpath, which passes through the allotment ground, a large excavation was made some years ago, and exposed about 15 feet of gravel.

'On the Lawford Road, on the opposite side of it to the Church and School at New Bilton, was opened in February, 1869, a small pit for sand. It is covered by greasy blueish clay, which deepens up the slope. The sand is of the usual type; containing many stones chiefly of quartzite and white grit and flints, and a dark limestone with white veins. I found none that were striated. Roots of trees very abundant. One bone, now in the School collection, was found in the clay, 2 feet from the surface.

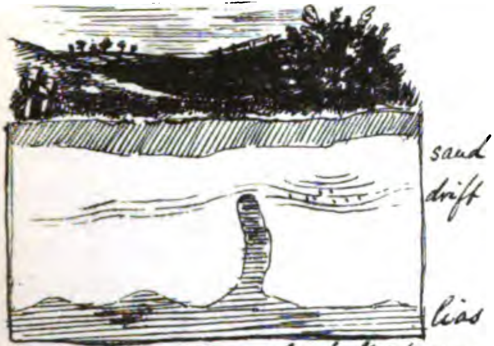
'At the New Bilton clay pits the gravel is from 6 to 10 feet thick, deepening as they work towards the hill. The gravel is very imperfectly stratified, though there are slight indications of stratifications; the quartzose pebbles, at least in one section, lie generally with their long axes vertical. The surface soil is easily separable from the drift. The remarkable feature at New Bilton is the inequality in the level of the clay. It is lias clay and never contains pebbles, but it is extraordinarily uneven; some ridges rising 5 or 6 feet in height, and overhanging their bases. The gravel lies in basins and in furrows in the clay.* Occasionally detached portions of the clay, or what seems to be detached, are seen among the gravel; but I have not been certain of a single instance of detachment. Stones are found imbedded in the surface of the clay, both upper and under surfaces: I have found no striated stones here. The drift is of the usual character, quartz pebbles, flints, and sand, sometimes in patches. Some years ago a well was sunk to the depth of 30 feet, which passed into the limestone rock. It may be noticed that the semi-detached portions of the clay in the upper part of the gravel often contain roots of trees, which are wanting in the gravel above. Many of the stones in the gravel are large, one or two feet in circumference. One detached mass of sand was very curious; it

---

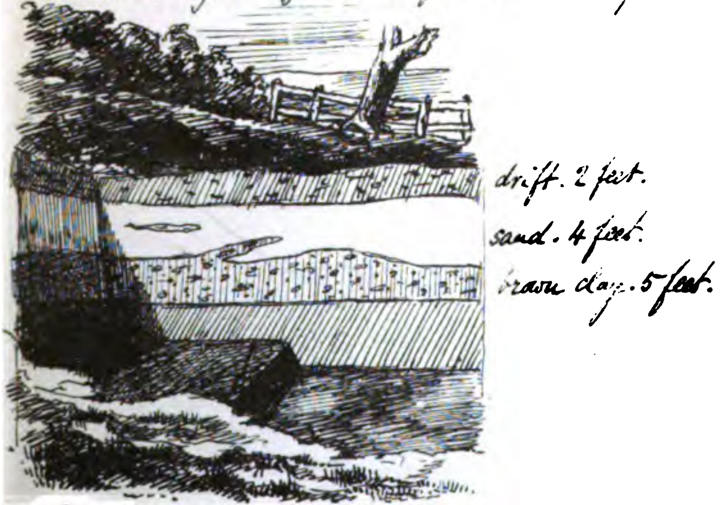
* Vide figures 1 and 2.



Section at New Bilton Clay pit. Feb. 1869.



Section at right angles to the former. March 27. 1869


drift. 2 feet.
sand. 4 feet.
brown clay. 5 feet.

Rugby pit. March. 1869.

was quite white, and as coarse as the roughest crystallized sugar, and was obviously derived from the decomposition of the cement which held together a block of white sandstone.

'Continuing to skirt the plateau we come next to that arm of the hill which runs between the Bilton and Lawford Roads, on which the Gentlemen's Cricket Ground is. By the side of the road from New Bilton to Old Bilton there is an excavation where both sand and clay are worked. The upper part of this hill is of sand, of the usual character, sugary, more or less dirty, stratified, sometimes diagonally, and in general at least without stones. It contained some crystals that looked like selenite, which I found some years ago, and have lost. This sand may by its appearance be correlated with that on the foot-path to Newbold, and at Hillmorton. It is overlaid here by a remarkable deposit about 5 feet thick, in the thickest part now exposed, consisting of marly clay, containing pebbles very evenly interspersed through its whole thickness. The pebbles most frequently are chalk, and these are generally striated. The clay is in some places sufficiently mingled with sand to allow of the percolation of water, and in consequence the chalk* is sometimes in a state almost of powder. There is a block of syenite of considerable size lying on the surface there, and a still larger one, weighing several hundred pounds, of a coarse grit, which is smoothed and striated longitudinally. There are reasons for believing that this clay with chalk pebbles is very partial on this hill, but that the sand is widely spread, and extends from there along the southern brow at least as far as Mr. Pennington's house. Of this sand and its extension along the southern brow of the hill we have already spoken. Higher up the valley, on the east side of the Dunchurch Road, close to the Roman Catholic Chapel, is a claypit and brickfield, and some of the sections made in it are particularly instructive. In March, 1869, there was exposed a face of undisturbed lower lias clay,* with a few nodules of limestone, containing ammonites; on it rested a layer of stiff brown clay containing many stones, but principally blocks of chalk. I obtained grit, (sometimes in large blocks, one of them 2 feet long, and 1 foot 9 inches broad and high), oolite blocks, upper lias fossils, rolled and grooved gryphæas, many flints, and quartzite pebbles, and hard veined stones. The chalk is found in pieces of all weights, from 1 cwt. down to dust, which can be detected in the clay with a microscope. Nearly all the chalk pebbles, and most of the other stones, are grooved and scratched. One slab of lias limestone, now in the Library, is very finely striated. Some arms of the clay, and portions of it apparently, and indeed really detached, lie in a bed of sand which in general rests on the uneven surface of the clay. These detached portions of clay resemble in all respects the layer just described. The sand is scarcely stratified, sugary, and contains grains of chalk universally. In some places pieces of decaying crumbling chalk can be seen. From an average sample consisting of 25 grammes of sand from this spot, Mr. W. H. Pike discovered in our Laboratory that 12½ per cent. is soluble in dilute hydrochloric acid, and consists of iron and carbonate of lime. Above the sand is the usual flinty and quartzose drift graduating into the surface soil. Higher up the hill at the Roman Catholic Chapel this drift is 8 and 10 feet in thickness, and thus thins out on the slope, and is wanting altogether lower down. Mr. Lloyd made a section from the wall of the Roman Catholic grounds across the old workings to this face of boulder clay, which is preserved in my portfolio. The height of the top of the drift in the section is 353 feet above the sea. It is noticeable that the surface of the lias clay is horizontal, but that the surface of the boulder clay is in furrows. These, as far as my observation goes, and it was confirmed by the workmen, generally follow the slope of the hill. Still there were basin-shaped hollows also.

---

* Some specimens of what I have called chalk were suspected to be white lias, but were submitted along with others from Sapcote to Mr. Tomes, and he decided that those from Rugby were chalk, and those from Sapcote white lias.

---

* Vide figure 3.

'As far as I know, this deposit of brown clay is here a small one. It does not seem to extend to the other side of the Barby Road, but there are not many places where it is possible to examine its extent. We have now returned to the triangular plateau of Rugby, Hillmorton and Dunchurch, and find that it is covered everywhere with gravel, sometimes reposing on sand and clay and with pebbles, but that these latter deposits are limited to the slopes of the plateau, and that in some places they are largely developed. We find also that lower down the slopes they thin out and disappear.

'The next part of the same plateau is the arm of it that runs back to Bilton and Cawston from Dunchurch and Thurlaston. This closely resembles the Rugby arm. At the Vicarage at Bilton there is 2 or 3 feet of gravel and then 23 feet of sand. This is on the slope of the hill; but at the top, at Mrs. James' house, is 13 feet of gravel over clay. At the Bilton Toll-gate, near the Blue Boar, is 7 feet of gravel, clay with pebbles, and then sand. At Cawston the gravel rests on reddish clay.* These facts are sufficient to indicate the nature of the deposits on the Bilton Plateau.

'As we proceed westwards, to that part of the same plateau which lies between Frankton and Church Lawford, we find the deposits becoming thinner in general. At Frankton there is 6 feet of gravel on the rock. At Church Lawford the same, though in some parts of it clay takes the place of the lime. At Wolston Heath the gravel rests on red marl to a great depth.

'I will now take a less detailed survey of the high lands that surround this Rugby Plateau, and are separated from it by the valley of Rainsbrook on the south-east, and by that of the Avon and its tributaries on the north-east: and finally describe the deposits in the valleys.

'Barby Hill is of lias clay capped in the southern part of it with marlstone. There are no sand beds or deposits of clay with pebbles that I can find; and the wells are fed by surface drains alone. The rock seems not to have been reached in any of the wells, some of which are 60 feet deep. At Kilsby, however, there is the same clay with chalk pebbles that has been already described; and large beds of sand. This is high ground, the level of the rails at the entrance to the tunnel being about 370 feet above the sea. The clay is very stiff, and is reported as being 30 feet thick, and resting on water-bearing strata. One well in Kilsby is 60 feet deep. One of the sand beds at Kilsby is well known from the trouble it caused when the tunnel was being made. About 200 yards from the south end of the tunnel clay 40 feet thick rests on sand, which is saturated with water and extends to great distances on each side of the tunnel. It was with the greatest difficulty that the tunnel was constructed through and under it, for the water seemed inexhaustible. An account of it may be seen in Smiles' Life of Stephenson, chapter xiii. of the small edition.

---

* The high ground continues to Holbrook Grange, where it slopes down to the Avon. There there is little gravel resting on rock. The wells are 30 or 40 feet deep in the rock.

'At Crick the gravel rests on the lias, and the same at Yelvertoft.

'In this direction, then, we learn that the high lands have deposits of the same nature, but less regularly distributed: the surface of the country is more diversified also and more picturesque.

'To the north, at Shawell, at Mr. Letts's is a well 70 or 80 feet deep, which passed in succession through gravel, clay with stones and chalk, and at the bottom reached a bed of sand in which water was found abundantly. At Swinford the wells are shallow, 10 feet, or thereabouts, in gravel resting on motherstone. Catthorpe presents some strange varieties. Some wells are shallow and supplied by surface drains, but there is one well of 46 feet, through gravel, clay with pebbles, and then sand, and finally 6 feet of lias clay, which serves as a cistern for the water.

'At Mr. Buchanan's old house, between Clifton and Lilbourne, on the brow of the hill, the gravel is 7 feet thick, resting on lias: and it is the same at other houses on the same level nearer Lilbourne.

'On the road from Clifton to Hillmorton, on the steep slope of the road north-east of the canal, was exposed a section of about 11 feet. At the top was stratified flint drift following the slope of the hill, and betwixt sand beds similarly stratified. This resembles the opposite side of the valley. In Clifton itself most of the wells are in gravel, about 15 feet; but that at the Manor House is 40 feet deep, in gravel, sand, and clay; and a very interesting boring was made at Mr. Newall's new house, halfway between the turnpike and the canal. Here there were 2 feet of earth, 10 feet of gravel and sand, and 43 feet of clay with chalk and other pebbles. The boring continued 40 feet further, and finally brought up clay without pebbles. On the opposite side of the road, nearer the railway, the sand under the gravel is worked. The gravel is the usual flinty and quartzose drift. The railway cutting here is just deep enough to enter the clay, which may be seen exposed in the drains at each side of the railway in the middle of the cutting. The chalk pebbles are distinctly striated. There is also oolite in the sand, and carboniferous limestone.

'On the opposite side of the Avon, at Newton, the gravel is thin, resting on clay with pebbles; and at 40 feet water is obtained, probably from sand: the same is the case at Mr. Rotherham's, where the well is 50 feet deep.

'On the railway cutting between Brownsover and Newbold, on the Rugby side of the canal, is sand mixed with loam, containing flints, syenite, and various kinds of quartzite. Beyond the canal are striated stones of various kinds, chalk and syenite in similar sand, which is there seen to rest on rudely stratified clay, which in its turn rests on stratified sand. The clay abounds in chalk pebbles. Some finely striated stones from this deposit are in the School collection.

'On the canal from Brownsover towards Newbold, between the Brownsover Road and the Midland Railway, is a mass of clay thrown up in forming the canal. It is reformed lias, and its pebbles are mainly lias limestones generally striated. I found no chalk there.

‘At Newbold the sand that overlies the lime quarries thins out towards the river and will soon cease to be visible. It was once 8 feet thick, but now less than 5 feet. It is soft, dirty, and sugary, and contains large blocks of a coarse gritstone, none of which are striated as far as I have seen. Some blocks of Leicestershire syenite are also found in it.

‘At Brownsover, at Mr. Boughton Leigh’s, there is sand 40 feet deep resting on lias clay. It resembles the Hillmorton sand. At a place nearer the mill, where Mr. Boughton Leigh once intended to build a farm-house, the well-sinker reports to me that he bored 60 feet through clay with pebbles, but reached no sand, and obtained no water, and the house was not built.

‘Coton House is on clay. At a farm near Brownsover, opposite Cosford, the gravel rests on rock which is used for building. At Churchover 6 feet of gravel rests on 36 feet of boulder clay. At Voile’s farm, one mile from Churchover, near Coton House, a boring of 150 feet was made, through a few feet of gravel, then lias clay, and finally the rock, like the Newbold rock at 50 or 60 feet. At Lutterworth the gravel and sand with large pebbles is 40 feet deep.

‘At Harborough we find sand and gravel to about 70 feet deep; and a certain barn about one mile from Harborough Magna, the well-sinker reports that he sank a well 90 feet through gravel (5 feet), clay with pebbles, and finally sand.

‘At Easenhall the gravel is deep and abounds in water.

‘At Newnham the wells are deep, 50 and 60 feet, in rock. Gravel is almost wanting.

‘We have now sketched briefly the nature of the deposits on the high lands all round the Rugby Plateau, and find that they do not differ in any essential respects, as to distribution, contents, or thickness. Everywhere there is gravel of varying thickness, resting in some cases on the lias limestone or rock, but still more frequently on either boulder clay or sand. The boulder clay and sand are generally found associated, and either may lie on the other. We shall now proceed to the examination of the valleys.

‘The Rugby Plateau divides the valley of the Upper

Avon on the north from the valley of the Leam on the south. At Hillmorton the water parting is very narrow and low, separating the Hillmorton brook, which flows down the Lilbourne valley, past Hillmorton and Butler's Leap, and joins the Avon at Brownsover Mill, from Rainsbrook, that runs from Kilsby, separating Rugby from Barby, to join the Leam near Granborough.

'For several reasons I judged the Hillmorton valley the most interesting, and have made more minute and detailed observations in it than elsewhere.

'I now give some altitudes above the sea that may be of importance in their bearing on the explanation of some facts.

'The altitudes of this stream and the Avon, that is, of the meadows, above the sea appear to be

at Hillmorton, near the Church, about	310 feet,
at Butler's Leap, on the Clifton Road	290 feet,
at Brownsover Mill	284 feet,
at the Planks	281 feet,
at Newbold	272 feet.

'The level of the rails of the London and North-Western in the cutting near Butler's Leap is 315, and of the Stamford and Harborough Line, where it crosses the canal near Clifton, is 318. The level of the water in the canal at the same place is 305.

'Mr. Newall's house is 332 feet above the sea, and the highest point in the gravel pit near it is 350.

'The valley near Hillmorton Church is very singular in its formation. All round the church and extending up and down the valley for a considerable distance is a peat bed, which is seen exposed in some of the deep ditches. Underneath it is sand, so impregnated with water as to be called a quicksand. It appears that this was not long ago a marsh, for Dr. Bucknill, of Hillmorton Hall, informed me that a sum of money was left to the parish to keep a causeway open over the marsh, and this was a floating road. The church is built on a slightly rising and firm spot in the flat valley. Sand overlies the peat at the bridge over the canal near the church, and appears to have been washed over it by rain out of the side valley in which the village lies, which contains the sand pits previously described. When the London and North-Western Railway was made it was necessary to make an embankment across this quicksand, and immense quantities of ballast and faggots were thrown into it to make a foundation; even now it is considered by some to be a floating road, supported on the faggots, and an undulation of the road is said to be observable.

'When the Canal was made extraordinary difficulties were met with, because the excavation at the locks drained the sand on which some of the houses rested, and their fall was imminent. Some of the houses in the neighbourhood rest on concrete, which in large slabs rests on the sand. This at the New Inn was sufficiently soft and wet to swallow up at once anything that fell on it. But of late years, I am told by Mr. Chamberlain that it is drier, ever since a deep drain, near the sheep-washing place, was made.

'I caused a boring to be made near the New Inn, but it was impossible to proceed further than 29 feet. The boring was 3 feet in peat, clay 1 foot, wet sand 25 feet. The sand was mixed with fine clay, and contained a good deal of lime, so that when dried it soon became perfectly hard. The microscope shewed grains of chalk and rolled quartzose sand. The depth reached in this boring must have been about 280 feet above the sea.

'The next boring made was in a meadow belonging to Dr. Bucknill, called the Moors. It gave 2 feet peat, 13 feet wet sand, 3 feet gravel, and then sand, more and more clayey and stiff, passing from yellowish to grey, until it became too stiff for boring at 53 feet. All this sand contained fine clay and chalk particles, effervesced slowly but continuously in acids, and was entirely unlike lias clay. The bottom of the boring was about 257 feet above the level of the sea.

'The next boring was on the left hand side of the road from Rugby to Clifton on the right bank, close to the stream. It passed through 6 feet of alluvial soil and clay, then a mass of vegetable matter, being the decayed vegetation of the old river bed, and reached sand similar to that higher up the stream at Hillmorton. Several stones were met with in this boring,* either flints or grits; and the lower part of the bore yielded a considerable proportion of chalk in the clay. This was persevered in till 57 feet was reached,† most of the tools broken, the pulley broken, and the owner of the field refused permission to continue the boring. The last thing reached was limestone rock, probably a layer of lias limestone. A board with specimens of the last 20 feet of the bore is in the Arnold Library. The depth of the bottom of this boring was 227 feet above the level of the sea.

'The last boring was close above the Planks, on the left bank of the river. It passed through fine yellow clay for 7 feet, then stone and sand for an inch or two, and then undisturbed lias clay. The boring was continued for 20 feet through this and then stopped. The depth here of the lias clay was 274 feet above the sea.

'In the Bathing-place above the Planks there is a ledge of limestone rock, dipping on the whole towards the S. W.

'In the valley passing through these borings the alluvial meadows are very narrow, the part that is flooded being in some places less than a stone's-throw across. Lower down, near Rugby, they widen considerably. The river winds among the meadows with a very meandering course, and is constantly slightly altering its course. Near Brownsover Mill a few years ago two concavities approached one another till they met, and the stream suddenly altered its course, leaving on its side a horse-shoe shaped lake, like those in the Mississippi valley. Traces of terraces, 3 or 4 feet above the level of the water meadows, are occasionally to be seen lower down the valley. The convexities of the larger river bends are generally, as at Newnham and Newbold, bounded by steep slopes of limestone.

---

* 2 flints, 1 much rolled, 1 metamorphic sandstone, 3 rounded quartzite, 1 fine sandstone, 1 iron stone, 2 laminated fine grits, 1 pure quartz pebble.

† At 55 feet some limestone nodules, the size of a nut, were met with and brought up by the borer. This boring was watched in my absence by Mr. C. Phillips.

'By far the most remarkable spot in this river valley is the pit from which Dr. Buckland extracted so many valuable mammalian remains. This is now a pit containing water, nearly filled however with sand washed into it by a little stream, in the field on the right bank of the river just above the Little Lawford Mill, very near the road to Rugby and Newbold. Buckland's "Reliquiæ Diluvianæ" contains an account of this discovery.

'The other valley of Rainsbrook and the Leam is of the same general nature. Alluvial meadows with a meandering stream occupy the centre, and the broad base of the valley is studded with many slight elevations. No borings have been made there, and there is no knowledge whatever of the subjacent deposits. At Willoughby some mammalian remains were discovered, about which Mr. Goldney, of Willoughby, was good enough to furnish me with the annexed extracts from Deacon's "History of Willoughby," (London, 1828). "The antediluvian remains which have been discovered at this place are the teeth and tusks of the mammoth or Asiatic elephant," p. 43. "The teeth first discovered in this village were dug out of gravel about 12 feet from the surface of the earth in a field near the Public School about 40 years ago (sc. 1788). There was discovered at the same time a tusk weighing about 30 lbs., 5 feet long, and curved to the amount of three-quarters of a circle....Another discovery of a tooth and tusk was made in this village about two years ago (sc. 1826), but the workmen broke the tusk. The remains of it, with some of the teeth, are in the possession of Mr. Wilkinson, the schoolmaster."

'Lower down these valleys, at Leamington, where excavations were being made in the Jephson Gardens, the bones of the elephant and rhinoceros were found.

'It remains only to speak of the alluvial soil in these valleys, and its contents. It does not appear to be anywhere very thick, perhaps 7 or 8 feet is the outside, and merely therefore fills up a depression in the previously existing valley. The present streams go on adding to the alluvial soil year by year, and must be considered as adequate to have produced the whole of it.

'The discovery of bones in this alluvium a few years ago caused considerable interest. The discovery was due to the industry and acuteness of Mr. E. Cleminshaw, who made the discovery entirely his own by finding several places where such bones may be found. The most interesting of these are in the bed and banks of the stream that runs by Newton, about a quarter of a mile above the village; in the Avon, a little above Newbold, at the bend close under the high ground at the back of the Butts; and in the Avon by the little bridge about 200 yards below the Mill at Little Lawford. Mr. Cleminshaw also found flints in these localities, which, in his opinion, and in that of some other competent persons, were flint weapons. I remain sceptical; on several grounds, and partly because in one of the localities, at Newton, there were found pieces of not ancient pottery, some broken bottle glass, and the bowl of a tobacco pipe.

'I trust the facts in the foregoing pages are authentic, and that they will be useful to any one who attempts to work out the latest chapter in the history of the surface of our midland counties.'

MEETING HELD MARCH 20 at the President's house, chiefly for the exhibition of microscopic objects.

Mr. Eyton (O.R.), Corresponding Member, read a Paper on '*Mesmerism.*' The Rev. J. Robertson lectured on a human skeleton belonging to the President. Foraminifera, botanical objects, spectra of various metals, &c., were exhibited under the microscopes.

MEETING HELD MAY 1:—*Donations:* Montivaltia Victoriæ from Middle Lias, Cherrington, by T. W.

Kirshaw, Esq. Teeth of Elephas antiquus and Rhinoceros leptorrhinus from gravel, Tilbury Fort, Essex, by J. Meeson, Esq. *Exhibitions:* Jaw of Skate with crushing teeth, Calcined black Poolvash Limestone, from between two trap dykes altered by heat, &c., by Mr. J. M. Wilson. Barbarea intermedia—new to the Rugby list—by the Rev. A. Bloxam.

A Paper on '*Paper Mills,*' sent by E. W. Prevost, late Associate of the Society, was then read.

Afterwards the Rev. T. N. Hutchinson read a Paper on '*Spectrum Analysis and what it has done.*'

'I think it would be worth while to lay before the Society from time to time brief notices of the more important discoveries that are made in different branches of science. Of course detailed accounts of such discoveries are always to be found in the scientific journals and periodicals of the day, but they are generally described in more or less technical language, and an amount of previous information is often assumed that is beyond what we have a right to expect from the majority at least of the members of a School Society. The interest attaching to the results of spectrum analysis in the case of the great solar eclipse of last year suggested to me one subject for such a Paper as I have described. Upon consideration, however, I felt that the spectroscope has lately been applied to the solution of so many ingenious problems, apparently of such very different characters, that it would be better for me to confine myself to a simple explanation of the general principles and phenomena of spectrum analysis, with a brief statement of the more remarkable discoveries that have been made by its aid.

'Every one knows that when we look at a bright object through a prism it appears fringed with coloured bands, the colours occurring in the order violet, indigo, blue, green, yellow, orange, red. It was Sir Isaac Newton who made the great discovery that white light is composed of variously-coloured rays, and that by means of a prism these

Fig 1

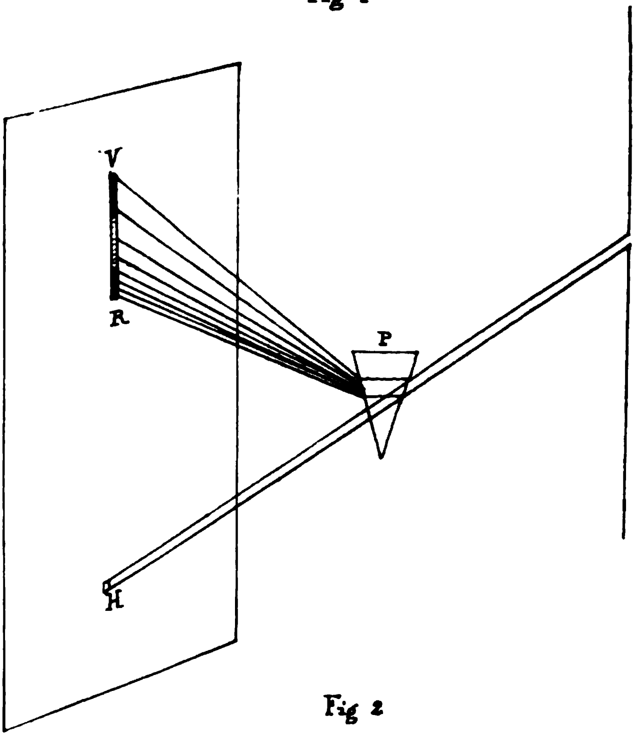
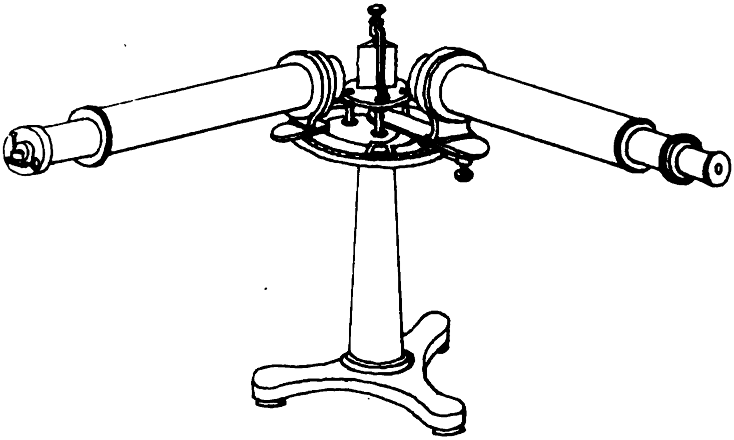


Fig 2



G.N.H.

coloured components may be separated from each other and spread out upon a screen. Such a strip or band of colours we call a prismatic spectrum. In the diagram (fig. 1) a beam of solar light is supposed to fall upon the prism, P, through a small slit, S. If the prism were away, the image of the slit would be formed on the screen at, H. By means of the prism, however, the whole ray is refracted or bent, and instead of the simple white image of the slit we have an elongated strip of rainbow-coloured light, VR, the upper portion violet and the lower red, with the other tints between. It appears, therefore, that each colour has its own special refrangibility, the violet light being the most bent or refracted, and the red the least.

'Now if we view the spectrum through a telescope it is seen with far greater clearness and distinctness, and a spectroscope is nothing more than an arrangement in which the light to be examined falls upon a prism through a narrow slit at one end of a tube, the spectrum formed being viewed through a small telescope placed at an angle with the tube containing the slit. One form of spectroscope is shewn in fig. 2.

'By placing such an instrument in front of luminous bodies of different kinds, the spectrum formed in each case can be accurately examined, and it is found that such spectra differ from each other in many important particulars. The method of interpreting spectra and deducing the nature of the bodies from which the light has emanated is called Spectrum Analysis.

'The spectra of all bodies that have been rendered luminous by heat may be referred to three classes.

'In the first, the coloured band into which the light is dispersed by the prism is perfectly continuous or unbroken: that is, the colours simply fade away into each other without the presence of any dark lines or bands. Such a spectrum is given by white hot carbon, by the incandescent lime in the oxyhydrogen light, by white hot iron, or magnesia, or in fact by any solid or liquid body in a state of incandescence: and the inference we draw whenever such a continuous spectrum is observed, is, that the light has emanated from an opaque body in a solid or liquid state. It is perhaps only fair to say that some later researches have rendered it more than probable that under certain conditions *gases* may give a continuous spectrum; but at all events, as a general rule, it is correct to interpret a continuous spectrum as indicating a solid or liquid source of light.

'In spectra of the second class we have no fading away of the various colours into each other, but a series of bright coloured bands with dark spaces between. Such a spectrum is produced when the source of light is a luminous gas. Glowing hydrogen, for instance, gives three coloured lines for its spectrum, red, greenish blue, and violet. The substance need not however be originally in the gaseous state: many solid bodies are converted into gas or vapour at comparatively low temperatures, and when such a body is heated till its vapour becomes luminous, a spectrum is obtained, each gas or vapour being distinguished by a characteristic set of lines. Hence when the spectrum of a luminous body is observed to consist only of bright lines of colour with dark spaces between, the inference we draw is that the luminous matter from which the light has come is in the state of vapour or gas.

'The third kind of spectra are more complicated. They consist of a strip of coloured light through the extent of which numerous dark lines are scattered. These dark lines, which indicate that light of certain definite refrangibilities is wanting, are not produced by the source of light itself. They are owing to absorption by vapours through which the light has passed before reaching the spectroscope, and which have robbed the light of some of the coloured rays of which it was originally composed.

'For example, if we view the spectrum of incandescent carbon or lime, we have, as you have heard, a continuous band of colours. But if we interpose between the source of light and the prism certain vapours, such as vapour of iodine, peroxide of nitrogen, &c., we immediately perceive the strip of colours to be furrowed by dark lines or bands, each band indicating the absorption of the particular kind of light that would occupy that position in the continuous spectrum. But the most remarkable fact connected with these absorption bands, as they are called, is that the group of *dark* lines produced by each vapour is precisely similar with respect to the number, size, and position of the lines, to the group of *bright* lines of which the spectrum of the same vapour consists when rendered luminous.

'For instance, if we burn metallic sodium, the sodium is vaporized by the heat, and the spectrum of the luminous sodium vapour is a bright yellow line in a certain definite position. Now if we interpose sodium vapour at a lower temperature between a source of light giving a continuous spectrum, (such as the electric light, or the lime light,) and the prism, we immediately recognise a black line in the otherwise continuous spectrum, this line being in precisely the same position as the previous bright yellow line. Thus clearly shewing that the sodium vapour has absorbed light of precisely the same kind or refrangibility as that given out by the burning sodium itself. Now when the solar spectrum is closely examined, it is found to be striped throughout its entire length by an almost infinite number of dark lines. The more important of these lines were first thoroughly examined by the German optician Fraunhofer, and after him have been called Fraunhofer's lines. By a careful comparison of these lines in the solar spectrum with the bright lines in the spectra of various terrestrial elements, sodium, magnesium, barium, iron, &c., &c., the two are found in many instances to coincide with the utmost accuracy.

'The inference drawn by Kirchoff and Bunsen from such a coincidence was that the corresponding vapours of these metals were present in the atmosphere of the sun.

'The first results of spectrum analysis were the addition of several new substances to our list of elementary bodies. As soon as the exact position of the bright lines in the spectra of all the known elements had been definitely determined, it was obvious that the appearance of a new band or set of bands would indicate the existence of a new body. In this way Cæsium, Rubidium, Thallium, and Indium were successively added to the list. Within the last few weeks another element, for which the somewhat questionable name of Jargonium is proposed, has been detected in certain specimens of a precious stone called a Jargoon (a variety of Zircon): Messrs. Sorby and Church are still engaged in endeavouring to ascertain the nature of the suspected stranger.* It is, however, in the domain of Astronomy that spectrum analysis has led to the most striking results. Some time ago Mr. Huggins, in conjunction with Dr. Miller, undertook the examination of the spectra of the heavenly bodies —the moon, planets, fixed stars, nebulæ and comets.

'Not much additional information was derived from the spectra of the moon and planets, since, as you know, they shine only by the reflected light of the sun. The spectrum of the moon was identical with that of the sun: no additional absorption lines were observed, such as would arise from the presence of a lunar atmosphere. The spectra of Mars and Jupiter, on the other hand, were found to exhibit additional dark lines, indicating the existence of absorbing atmospheres.

'The fixed stars exhibited spectra similar in general character to that of the sun, but entirely differing in the number and arrangement of the dark lines. In the greater number of the stars examined the presence of hydrogen, sodium, magnesium, barium and iron was considered to be satisfactorily proved. One remarkable fact was discovered, viz. that a small number of stars appear to be entirely destitute of hydrogen. Mr. Huggins also examined very carefully the spectra of many coloured stars, and he arrived at the conclusion that the actual light emitted by all the stars is white, and that the colours are due to the absorption of light of certain refrangibilities in its passage through the atmosphere of the star.

'The application of the spectroscope to the nebulæ led to results of great value. Since the erection of Lord Ross's telescope, and the resolution by its aid into clusters of stars of nebulæ that had previously been regarded as irresolvable, it had been assumed that with increased optical power *all* the nebulæ might be similarly resolved and be proved to consist of aggregations of myriads of stars.

---

* Mr. Sorby has since discovered (Feb. 1870) that the spectrum in question was *not* due to a new element, but was simply caused by the presence of a most minute portion of oxide of Uranium with Zirconia.

'In August, 1864, Mr. Huggins turned his spectroscope to a bright nebula in the constellation Draco, and he saw at once that its spectrum consisted of three bright lines alone. These lines shewed that the light from this nebula was not emitted by incandescent solid or liquid matter, but by glowing or luminous gas. The great nebula in Orion gave three similar lines. About one-third of the nebulæ examined were found in this way to consist of luminous gas, probably hydrogen and nitrogen. The remaining nebulæ examined gave apparently continuous spectra, most of these having been more or less resolved into star clusters by Lord Ross.

'Last year (1868) Mr. Huggins examined the spectra of the two comets which were visible in May and June, and he satisfied himself that their spectra, which consisted of three bands of light, were absolutely coincident with the spectrum of carbon. Whatever difficulty may exist in the way of accounting for the intensely high temperature at which alone it would be possible to vaporize carbon, the conclusion that the nucleus of the comets examined were composed chiefly of carbon in the state of glowing gas appears to be irresistible.

'The next result of spectrum analysis that I have to mention is one of extreme interest. Many of you are aware that whenever a total eclipse of the sun occurs, curious coloured flames or protuberances are invariably seen projecting from the edge of the obscured disc. Endless enquiries were suggested by these strange appearances. Had they any actual existence at all, or were they only optical illusions? Did they belong to the sun or to the moon? Some suggested that they were solar or lunar volcanos in vigorous action, others that they were solar auroræ, or possibly incandescent clouds floating in the solar atmosphere. The remarkable solar eclipse of last August (1868) enabled this question to be solved by the spectroscope. The spectra of the prominences, taken by many independent observers, while differing more or less in detail, were seen to consist only of bright lines. This shewed at once that the prominences were composed of incandescent *gas*, and from the position of the bright lines this gas was probably hydrogen. Moreover, further examination has led to the conclusion that the protuberances themselves are simply local accumulations of a vast gaseous envelope completely surrounding the sun. The thickness of this envelope has been estimated by Mr. Norman Lockyer at about 5000 miles on an average, but the prominences sometimes rise above it to a height of upwards of 100,000 miles. These stupendous masses of incandescent gas are in a state of constant agitation, frequently breaking up and changing into totally different forms in the course of a few minutes. The envelope itself has been called the chromosphere, to distinguish it from the bright photosphere which forms the visible disc of the sun: the chromosphere and photosphere together forming the true solar atmosphere. Since the eclipse took place methods have been devised by Mr. Norman Lockyer and Mr. Huggins, by which it is possible not only to see the spectrum of a protuberance without an eclipse, but also to detect the actual forms of the protuberances themselves and observe the changes they undergo from time to time.

'Mr. Lockyer has also found the phenomena of sun spots to be closely connected with the formation and disappearance of the protuberances, and it is probable that much light will be thrown upon this subject by his further researches.

'The last discovery made by the spectroscope is, perhaps, the most remarkable of all. I can do no more than allude to it, as an explanation would involve points of considerable difficulty, and would at least require as much time as I have taken for the whole Paper.

'In examining the bright lines of hydrogen in the spectrum of the splendid star Sirius, Mr. Huggins found that by increasing the power of his instrument he was able to detect a minute difference between the position of one of the hydrogen lines in Sirius and the corresponding line in the spectrum of terrestrial hydrogen.

'By a process of reasoning of singular refinement and ingenuity, he has shewn that it is at all events highly probable that this difference is accounted for by a motion of Sirius from the earth of about 29 miles per second.'

N. Masterman read some Remarks on the '*Green Snake*' (see page 14), producing a pet snake of that genus from his pocket.

At a meeting of the Members afterwards, J. R. Dakyns, Esq., of the Geological Survey, and F. W. Fison, Esq., were elected Corresponding Members.

MEETING HELD MAY 15:—*Exhibitions:* Cardamine Amara, with double row of petals and no stamens, by G. H. Harris. Photographs of a Gorilla, by G. Darbishire. Kingfisher and Whinchat's nest and eggs, by N. Masterman, &c.

Rev. C. J. E. Smith read a Paper on '*The Viviparous Production of Plants,*' illustrated by viviparous specimens of Cardamine pratensis from a ditch on the Hillmorton Road.

F. R. Smith read a Paper on '*Bats.*'

MEETING HELD MAY 29:—*Exhibitions:* Asplenium Viviparum and Bignonia, by Rev. C. J. Smith. Cynoglossum officinale, by the President. Fir Wood bored by Teredo, by Mr. J. M. Wilson, &c.

Mr. Wilson continued his Paper on '*The Gravel System of Rugby,*' which has been printed at page 16.

Dr. Farquharson read a Paper on '*Recent Discovery in Snake Poisons.*'

MEETING HELD JUNE 12*:—Exhibition:* Sweet William with four connate leaves forming a sheath, by the President. *Donation:* Fish with two heads, by C. R. Byrne.

F. Lefroy read a Paper on '*Beetles,*' illustrated by numerous paintings and specimens.

Rev. T. N. Hutchinson gave an Account of 'The Boring Molluscs,' of which he exhibited a large quantity from Tenby.

MEETING HELD JUNE 26*:—Exhibitions:* Proliferous Roses, by Mr. Sidgwick. Asparagus Beetles, by F. Lefroy, &c.

The President spoke on a variety of the White Lychnis growing behind the Roman Catholic Chapel.

N. Masterman spoke on 'Lizards,' exhibiting a pair of Green Lizards and their eggs.

MEETING HELD JULY 10*:—Exhibitions:* Conchoidal fracture in a Flint from the Close, by Mr. Wilson. Rattle of Rattle Snake (Crotalus horridus), by Rev. T. N. Hutchinson. Cipos from above Para, on the Amazons, by F. R. Smith.

N. Masterman spoke on the several kinds of Tortoises, and exhibited living specimens of several kinds.

This was the last Meeting of the Summer Term.

MEETING HELD OCTOBER 2*:—Donations:* Snakes and Centipedes from India, by F. Gardner. Reports of Marlborough College Society, Wellington College Society, and the Warwickshire Field Club, by the Societies. *Exhibitions:* Tusks of Walrus, by H. R. Ricardo and F. Lefroy. Glass-rope Coral (Hyalomena Sieboldii) from Japan, and Garnets in Mica-schist from Zermatt, by Rev. T. N. Hutchinson. Pholas Borings from Heidelberg, &c., by Mr. Wilson. Specimens of Cucullia umbratica with Pollinia of Habenaria Chloranthus sticking to their eyes, by W. C. Marshall, &c.

The President read a Paper on '*The Working of the Meteorological Office,*' illustrating it by maps presented by Mr. R. Scott, (O.R.)

MEETING HELD OCTOBER 16*:—Exhibitions:* Sponges from North Sidney, Australia, by F. C. Bayard. Euplectella Speciosa, by the President. Two Leaves (modified petals) growing out of a Fuchsia's Calyx, by C. T. Clough. Spiculæ of Geantia Compressa and of Alcyonium, by Rev. T. N. Hutchinson.

F. C. Bayard read a Paper on '*Sponges.*'

MEETING HELD OCTOBER 30*:—Exhibitions:*

Mantis Religiosa, 'The Praying Mantis,' by F. R. Hodgson. Wing and Tail-feathers of Imperial Eagle, by N. Masterman. Fossil Pipe Coral and Carboniferous Limestone, by W. B. Lowe, &c.

Mr. Sidgwick read the following Paper on '*Norway*,' which he illustrated by many photographs and Norwegian products:

'In making a few notes upon the natural features of Norway, I shall venture to take the only course in which I could hope to set down anything that could interest anybody; and that is, not to extract any information from books of reference, nor to quote any statistics, but simply to try and describe just the things that interested me in a five weeks' tour, exactly as I saw them. And if I use the phrase natural features in an extended sense, so as to include some points of interest not entirely natural, I hope I may be forgiven.

'In its geography, Norway is the easiest of all countries in the world. It is shaped exactly like a pear with a long stalk. From the end of the stalk to the head, runs one chain of mountains, absolutely continuous. In the body of the country, the juicy part of the pear, there are valleys running from each side of the hills to east and west; but the hills never completely vanish, and there is no plain in Norway, properly so called. The stalk, which is about 800 miles long, exclusive of endless indentations of shore, is simply a chain of hills and a coast line. At the head is Christiansand, at the junction of stalk and fruit is Throndjem, between Throndjem and Christiansand, halfway down the west coast is Bergen, and opposite it on the right or east coast is Christiania, the capital. At the end of the stalk is Hammerfest, the most northerly town in Europe.

'The first view we got of Norway was in a cloudy morning on the first of August. The dim heavy atmosphere shewed us at once that we were in a region where the Gulf-stream produced wet as well as warmth. The whole of the west coast, like all Atlantic west coasts, is liable to much rain; except where beyond the Arctic Circle the eternal summer sun makes the weather clear. Bergen is the wettest place in Europe, by all accounts. "Does it rain much at Bergen?" I asked a mate on board one of the Norse boats, who was a bit of a wag. "No, not much," he replied, "only about seven days in the week."

'In a few hours we were steaming in perfectly smooth water up the fjord which leads to Christiansand.

'This is the best opportunity for a word upon fjords.

'All the ideas I had about fjords before going to Norway were derived from Miss Martineau's beautiful little tale, Feats on the Fjord. That prepared me for a great deal of beauty in the fjords, but not all for the wonderful variety, of which I must try to give some idea.

'The whole coast of Norway is indented in the most marvellous manner. From Christiansand to Hammerfest, more than 1000 miles as the crow flies, there is not a straight piece of shore to be found a mile or two in length. The sea has eaten out the shore, till it is as ragged as a piece of linen which has been worried by a dog. The arms of the sea, which are called fjords, run up inland in some cases 80 miles, often as much as 20, or 30 or 40. Christiania is a port, though it is 60 miles from the open sea. Throndjem is a port, though after weighing anchor the main sea is not reached for four hours.

'What, then, is a fjord like? It has many various appearances. The Christiania fjord is very long and narrow, and surrounded with low wooded hills, like Windermere. The fjords on the west coast are perfectly different, and grand beyond description. You sail up a calm deep blue strip of water between hills and cliffs 2000 and 3000 feet high on each side of you, rounding point after point, and each time discovering a new reach of unexpected beauty, till you are quite bewildered. The waterfalls come straight over the cliffs into the sea, and so quiet and secluded and mysterious is the place that it is almost impossible to fancy yourself not upon an inland lake high up among the mountains. "How high is that rock?" I asked an Englishman while sailing in a place like this I have been describing. "Oh, about 2000 feet," he said, "and then we must be *some* 1000 *feet up here already*." And that too while we were actually on the sea water at the time.

'Sometimes again the fjord will open out into a smiling lake, dotted with islands and indented with bays, mountains of all shapes rising up on every side, like nothing that I have seen elsewhere.

'A fourth and quite distinct kind of fjord is that in the Arctic regions, in its own way perfectly unsurpassed for splendour. Imagine a wide reach of sea, right in the middle of snowpeaks: range behind range in every variety of shape and distance, sometimes pierced by a narrow subfjord, like an adventurous offshoot desiring to explore, sometimes dropping a viscous glacier to within apparently a few feet of the sea, though never quite reaching it, sometimes standing by itself in a clustering island, white above, red crags below, blue sea all round it.

'So much for the fjords. It was not till I had been in Norway, that I realized we had fjords in the British Isles. The long arms of the sea in Scotland, which they call lochs, are really fjords. Loch Fyne is a noble fjord, and the view of the Isle of Arran is very like some of the Norse scenes. In Ireland I believe it is much the same.

'But oh the rivers! The first day we set foot in Norway shewed us what we were to expect in the way of rivers. The Torrisdal Elv at Christiansand is a river which makes your mental mouth water even to remember. Flowing first through a lovely defile, then through moors and fields to the sea, it is 500 yards broad at the least, blue, deep, and swift,—a luxury of loveliness to one like myself, with whom bathing is a passion, and who can almost sympathize with the old Roman worship of rivers. I had two bathes in it that afternoon, a good prelude to the endless waters of Norway. And this river is not the largest or the finest by a long way. It is only one among hundreds, all equally glorious. To the immense rainfall, no doubt, is due the maintenance of these splendid rivers. It is an ill wind that blows nobody any good, and the south-west wind, though it makes Norway terribly wet, makes it also the most astounding reservoir of fresh water in Europe.

'From Christiania to Throndhjem we crossed in carrioles, the regular vehicle of the country; but before leaving Christiania I must mention the pilot boats which greeted us on our entrance into the fjord. The only rough part of our voyage was just in the Skagerrack before we turned round into the Christiania fjord. It is always rough here. The Baltic current sets straight out into the North Sea, and meets the Gulfstream running in nearly an opposite direction. They fight it out, and the result is more perceptible than pleasurable. We were just in the middle of this rolling and jolting, when out came three little nutshells of pilot boats, to see if we wanted a pilot. They were tossing as if the next moment the sea must engulf them; the night was closing in rather wild; and as they heaved past the steamer the inarticulate roar above the sea's noise with which they hailed us, and asked if we wanted a pilot, was all calculated to impress a landlubber as something out of the reach of his ordinary experiences.

'The carriole is a little carriage, with just room for one. Your luggage is strapped behind, and a boy goes with the party to take back the horses. Each stage is about 10 miles. The little yellow ponies are capable of infinite labour; and you think nothing of trotting 50 or 60 miles a day, though a good deal of it be up-hill. In this merry way we reached Throndhjem. This town lies on a peninsula made by a river; and is chiefly distinguished for its cathedral, its wooden houses, its stinks, and the splendid view of the fjord and hills from the town. Of the cathedral and town, with the harbour and fjord beyond, I have a photograph, which I shall pass round.

'From Throndhjem to Hammerfest, that is, all up the stalk of the pear, we went by steamer. The voyage takes a week; the whole time the water is sheltered behind islands and rocks, so that there is not more than 6 or 7 hours of open sea in the whole week's work. From end to end one passes over 7 degrees of latitude; for Throndhjem is 63 degrees, and Hammerfest is 70 degrees, 3 clear degrees north of the Arctic circle. The scenery the first day is rather dull. The rocks are all *moutonné* with extinct glaciers, and the number and extent of these low sheep-backed islands quite desolate and bare, exceeds belief. If all the *moutonné* rocks in Norway were laid end to end, I venture to say 20,000 miles would be an estimate below the mark.

'After the first day it becomes grand, and gets finer and finer till (a day's voyage from Hammerfest towards the North Cape) the country sinks again into dulness. But anything like the infinite and grand shapes of the rocks for hundreds of miles, especially in the Lofoten Isles, where the shapes are best, and the northern fjords where the snow makes the view ineffable, I have never conceived. For days you wind in and out of green and red and black crags unending and never one like another. Further north, it is as though you were suddenly transplanted into the centre of Switzerland; with all the low valleys and dull plains filled up by sea; and only the noble ice-peaks projecting.

'Amongst the Lofoten Isles the channels are so narrow that the currents are fearful; it is here that the famous Maëlström is to be found. One of these currents I specially watched. The waters met from two sides at once, and apparently the fish were bewildered for the gulls were crowding till the whole sea was speckled with them. The boats which were fishing after rowing painfully out into the middle abandoned themselves to the current, and away they went like a flash.

'The long Arctic day was a revelation to me. Of course I was too late, as we did not cross the line till 13th August, for the midnight sun; but the midnight twilight, or rather daylight, is really quite as remarkable. The lights were glorious. One day the sunset was fine, and we watched the splendid red glow all over the whole sea, which was as calm as death, for nearly four hours without ceasing. To see the sun actually go down behind a calm sea is a sight; but to see the sunset lights from half-past eight till after midnight is wonderful.

'Further north it was lighter still. It is one thing to know that the daylight lasts through the night in the Arctic regions; it is another thing quite to sit on the deck of a mail steamer, passing up between lovely hills, on a still warm night, and read a book, as I did, between twelve and one o'clock by *daylight.*

'At Hammerfest there are huge cod liver oil manufactories which occupy nearly the whole energies of the town. All the houses on the quay are of this description, and the smell of cod liver oil is permanent. I should think a consumptive patient would be cured at Hammerfest, if he went and lived there a week, merely by inhaling the odour. We got into a boat to bathe, according to custom, at once. But the whole harbour is coated with a fine film of the engaging fluid, which gives one quite a new interpretation of the phrase 'oil upon the waters;' and we were forced to go outside the bay for a dip.

'Hammerfest is the great port for whaling, bearing, and walrusing expeditions to start from, when bound for Spitzbergen, Nova Zembla, Jan Mayen, and the Polar Sea generally. We saw an immense number of polar bearskins being cleaned in a lake there; and the trade in all manner of furs is very brisk. We fell in with a boat on our way back which had been fishing all the summer and had an immense cargo of walruses, and wanted to be towed into Throndhjem, but the price our captain asked was too much.

'For the following fact a Norseman I met is authority. The great evidence in its favour is the circumstance that he told it without seeing it was humorous.

'There is a fish near Hammerfest called the ground shark; it is so voracious that when one is hooked by a fisher, before he can draw it up, another fastens on to the first, and swallows it; another then fastens on to the second, which in its turn has its body eaten off by a fourth; so that the wretched fisherman draws up 3 or 4 heads, often with no body attached.

'On our way back from Hammerfest we saw a whale (or what at any rate was very like a whale). The spouting is a fine sight, though of the beast itself you see only a black line at the top of its back. The birds all over these parts were infinite. Gulls, cormorants, terns, and eider ducks in thousands, were to be seen everywhere. Sometimes we came upon a muttoned rock which was arbitrarily selected as a perch, and which was alive with them; sometimes a spot in the sea pleased them, and they floated merrily in the sun by hundreds; and once or twice the steamer would drive right through such an assembly, causing it to be suddenly adjourned *sine die* amid much confusion.

'The most prettily situated town in the north is Tromsö. We went up a hill at the end of the valley across the sound, and were suddenly in a sublime circle of snow hills. The view was quite of its own kind never to be forgotten. On our way down, we caught sight of a lot of little crawling things in the valley, like ants, at that great distance. Lower down they grew bigger, and suddenly it flashed on us that they were a herd of reindeer. Sure enough they were, about 1500 of them, being slowly driven down the valley by two Lapps. We passed through the herd, which make a curious creaking noise with their cloven feet, and lower down the valley we came upon a real Lapp hut. Outside, a round low cabin built of sticks and turf, with a hole at the top for smoke; inside, all brown—two brown women, three brown children; and various specimens of art, as reindeer boots, spoons, &c., which we bought for a few shillings. The men were all dressed in reindeer skins; boots, coats, and all being of the same material. They eat reindeer, dress in reindeer, and make most of their simple utensils out of reindeer horn.

'I must mention another tale, which was told of the Finns, and which several people independently swore was true. The Finn drives himself in a small close-fitting sledge, which covers all his body like a wooden shell. The reindeer is a most willing beast and will go miles before he is tired. But when he *is* tired he is distinctly disagreeable. Instead of going slower, like a horse, he suddenly without any warning stops dead. Then indignation at being overdriven suddenly rises like a tempest in his bosom and completely carries him away. In an ungovernable fury he steps back to trample his persecutor to death. But the Finn knows him, and at once when he stops turns quietly over, so that the sledge covers him like a snail-shell. On this the reindeer tramples harmlessly; his passion is soon exhausted; he becomes as quiet as a lamb; the Finn turns over again, and lets in as hard as he can lash, and the reindeer goes merrily on for another spell.

'I must run briefly over a few remaining points of interest.

'In sailing north, one most striking feature is the extent of raised old sea-beach. As far as the eye can reach, you see a line running along parallel to the sea-level, some 50 feet as it appears above the water. Close to the shore it is not so well marked, but to one a little way out in the fjord, the line seems continuous. It continues for hundreds of miles, and is perfectly unmistakeable.

'Between Throndhjem and Bergen we passed Christiansund (not the same as Christiansand), the strangest town in Norway. You sail along the coast, the rocks being bare, *moutonné*, and monotonous; at one point you see a narrow channel dividing the rocks and running a little inland, as it does every few hundred yards; with one house standing at the entrance. This looks simply like a solitary fisherman's dwelling, of which there are thousands; and you no more suspect a town there than an elephant. Yet in you go through the narrow channel, and there you are at once in a circular basin of water half a mile across with the smiling town of Christiansund all round you. It is like a fairy sight.

'At Bergen, wet though it is generally, we had four cloudless days, every night a beautiful Aurora Borealis. "Come, and see the Aurora," I said to our landlord one night. "That," said he, with contempt, "that's nothing—we have it here on every clear night; you should see it in the winter." And certainly if it is better than what we saw I wish I could.

'Some of the settlements on the west fjords are marvellous. The rocks come down almost sheer into the sea: yet wherever a few square yards of the poorest grass will grow, there is a Norse hut, with boathouse below and a break-neck path up. They live in places whence they can go away only by sea; for they cannot pass to each other along the precipitous cliffs; and at the top there is endless desolate snow. When they go out for the day, they tie their children to a stake that they may not fall over; and they themselves often mow their grass with a rope round their middle by which they have been let down into their vertical hayfield, and by which they are drawn up with their bundle. One is surprised to learn that in the face of these almost insuperable difficulties almost every child in Norway gets a good schooling.

'I will conclude with a tale that I heard from the captain of a steamer on the Storfjord.

'In the 14th century the Black Death, after decimating a certain village on the fjord, was proceeding northward in his fatal career. To do so he had to cross a certain hill, and so up he went. Now it chanced that a Troll lived in this hill, who had no idea of having trespassers on his property, be he Black Death or any other man. So he rolled down stones on the head of the invader, and killed him.

'This must be a true story for two reasons:—first, because the Black Death went no further north than this village; secondly, because the stones which the Troll rolled down are there to this very day, and I saw them with my own eyes.'

Mr. Wilson described Mr. Seabroke's (O.R.) Invention for Polishing Glass Specula, or mirrors for large reflecting telescopes. The following account has been sent to us by Mr. Seabroke.

'The Specula were obtained from Birmingham, and were 9in. in diameter and 1¼in. in thickness, nearly flat on both sides: both of them were ground and polished in the same way in the following manner. A circular block of iron of nearly the same diameter as the Speculum, and 2in. thick, was turned to a convex surface on one side, having nearly the same curve which the Speculum was intended to have, viz., a curve of 12ft. radius; this was placed face upwards and coarse emery and water put on: the Speculum was then placed on the iron and worked by the same machine (to be described hereafter) by which the polishing was done; a pin was fastened by pitch on the back of the Speculum in the centre, by which the Speculum was worked; the Speculum was pressed on the iron by a bar of wood about 4ft. long with its centre resting on the pin on the Speculum and one end held down by a string to the floor, the other end having a weight of about 20lbs. hung to it by a string; the weight was kept from swinging about by other strings attached to it. By this means any amount of pressure could be exerted on the Speculum without the weight interfering with the motion of the Speculum. Each of the Specula took about 6 hours to grind all over, fresh emery being sprinkled on with water every 10 or 15 minutes. When the Speculum had been ground all over, the pressure was taken off and the fine grinding commenced with "emery flour" well mixed with water and the coarsest particles separated by decantation. After all traces of the scratches and holes of the rough emery had disappeared, finer emery was used, separated also from the emery flour by decantation, and then finer and finer still was used till the Speculum when dried reflected the image of a candle at an incidence of 45 degrees; this occupied about 6 hours.

'When I had ground the Specula all traces of emery were carefully washed away from the apparatus, and the polishing commenced. The polishing apparatus consists of a piece of board about 5ft. long, having near each end a wooden wheel fixed so as to revolve horizontally. These wheels are connected by a band running round both. The circumference of the wheels are in the proportion of 120 to 121 to each other, so that while one revolves 120 times the other revolves 121 times; a pin is fixed on the top of each wheel, which gives motion to a rod of wood; the two rods are of the same length as the distance of the centres of the wheels, and there is a hole at the end of each rod to hold the pin on the back of the Speculum to in grinding, or the pin of the polisher in polishing. When the wheels are turned by the engine, this pin is carried by the rods through a series of curves, changing from a circle through ellipses to a straight line, and *vice versâ.* The Speculum was laid face upwards on 3 or 4 thicknesses of soft carpet and a strap passed round it to keep it in place. The polisher consisted of a circular piece of wood 1in. thick and 11in. diameter, made up of two pieces glued together with the grain crossed to prevent warping. Pitch was spread on this to the thickness of about ½in., and covering a circular area about 9½in. across, a pin was fastened on the back of the polisher in the centre by which motion was communicated to it; the pitch was softened by holding the face of it under the surface of hot water, and then placed on the Speculum and moved gently about till the pitch exactly fitted the Speculum; it was then cut to a circle having a diameter in proportion to the diameter of the Speculum, as 1.05 : 1, which in this case was 9½ nearly; it was then divided into nine 1in. squares by cutting v shaped grooves across it crossing each other at right angles; the polisher was then again warmed and placed on the Speculum and worked by the apparatus for a few minutes with water only to ensure accurate fitting; rouge was then applied with the water, adding fresh rouge and water every 10 or 15 minutes or whenever the polisher began to work too hard. This operation was continued till the surface of the Speculum had received a perfect polish. If the working was stopped for more than about an hour, the polisher being off the Speculum and kept face upwards, the pitch altered its curvature and had to be warmed before working again. The polishing occupied about 12 hours altogether, the wheels making about 100 revolutions a minute, and the pins on the wheels were placed 1in. from the centres. Both Specula were ground and polished up to this point in exactly the same manner. The Specula were then tested on a star before being silvered and both gave the same results, showing that their figures were not obtained by accident. They divided two stars 2.5″ apart, but a large amount of stray light surrounded the image, and by using diaphragms the focus of the edge of each Specula was found to be longer than that of the central portion, shewing that the curve was an hyperbola instead of a parabola. One of the Specula (which we will call No. 1) was then put on the apparatus again and worked with the same sized polisher as before (viz. 9½in.), but with double the length of stroke used at first, the pins on the wheels being placed 2in. from the centres. The Speculum was worked in this manner for 2 hours and again tried, but it gave nearly the same results as before, but the curve was not quite so regular.

'No 2 was then put on the machine, but instead of altering the stroke the size of the polisher was altered to the same size as the Speculum: it was worked in this manner for 2 hours and then tried. The stray light seen before had entirely disappeared, but the definition under a power of 100 was not perfect. This might have been due to atmospheric causes, as very few nights admit of the use of 9in. aperture, and as clouds came over suddenly during the trial, there was no time to use diaphragms: or the Speculum in being altered has taken an irregular curve, which will probably be rendered regular by continuing the process. At any rate, further trial is necessary before the cause of bad definition can be laid to the Speculum. It is my intention to work No. 1 in the same way as No. 2, viz., with a short stroke and polisher of the same size as the Speculum, and then to test them together in order to eliminate the chances of accidental curvature.'

MEETING HELD NOVEMBER 13:—D. Ogilvie read a Paper on '*Bees.*'

Rev. T. N. Hutchinson described the Structure, &c., of Corals; his remarks were illustrated by diagrams, and some specimens brought from his house of great beauty and rarity.

The President read '*An Account of an Ostrich Hunt,*' contributed by N. Larden (O.R.), our Corresponding Member in the Argentine Republic.

'On the 8th August, 1869, we went out for a grand ostrich hunt, mustering in all nine Englishmen and twenty-one natives; we started about eight o'clock. Before we got far from the house, we literally rode over an unfortunate doe, that the dogs ahead of us had pulled down. One of the party jumped down, killed, and skinned it. Soon afterwards we separated into two bodies, each diverging from the other at a slight angle. After galloping for about two leagues, we began to drop men, one by one, to form the circle. When the circle is completed, *i.e.*, when the men are in their places, everybody advances very slowly towards the centre, the men on one side appearing to those on the opposite one like diminutive ninepins, the circle being two or three leagues across. The deer and ostriches then clear out at what they think is the biggest gap; but, of course, the men on either side galloping towards each other, close in upon the frightened game, and each gets a throw with the bolas at deer or ostrichs. When once the animals have determined to cut the circle at such or such a place they never turn back, although an ostrich one day on seeing me right in his path dropped suddenly in the long grass, and I in vain trod over the place in search of him. When the circle gets very small, the result is just the same as when a reaping machine at home gets to the end of a field; and those animals who have stayed and stayed, find they must bolt, and then is the real sport. Many Jauchos carry as many as three pair of bolas, but two pair is the ordinary number; two pair are necessary not only because one pair frequently bursts, but in order that if they miss with the first pair, throwing down their hat to mark the place, they may continue the chase with the other pair. I have known natives ball two ostriches from a troupe at a run in this way. At last there is nothing more to escape, and so closing up to the centre, and loosening our horses' girths, we sit down, and each man talks of his success or failure. After sitting for a quarter of an hour, we divide off again to form another circle. We generally are out about eight hours, during which time we cannot form more than three circles. Tell the Society I have got a long letter for them on "The Inhabitants of a Bischacero, or Native Rabbit Warren," but I am keeping it to put in the dimensions of a certain part of the bischaca. I am also making a list of the birds of the Pampas, and writing notes on any curiosity that I notice; also the productions (birds, insects, etc.) of each month.'

MEETING HELD NOVEMBER 27:—Exhibitions: A remarkably large group of very young Anemones on a single stone, brought from his sea-water aquarium by Rev. T. N. Hutchinson. Curious section of wood, by E. A. Burchardt: explained by the President.

Mr. Wilson concluded his Paper on '*The Surface Drift at Rugby*' (see page 16).

The President lectured on 'Pollen on the Eyes of Moths,' with diagrams.

H. O. Leggatt read a Paper on '*A late Halo round the Moon.*'

This was the last Meeting of the year.

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

RUGBY SCHOOL NATURAL HISTORY SOCIETY.

1870.

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

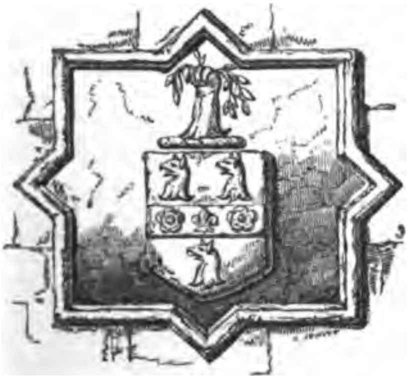
REPORT

OF

THE RUGBY SCHOOL NATURAL HISTORY SOCIETY

FOR THE YEAR

1870.



" IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

— BACON.

RUGBY: W. BILLINGTON.
1871.

PREFACE.

THIS, our fourth Report, dates from the Society's Room. At last we have a Museum of our own, distinct from the Arnold Library. It is true that our Library is small, it is true that Cases for our Botanical and Entomological Collections are only just presented to us, and both these collections only in course of arrangement, it it true that our room is not yet fully furnished, but yet there is all the difference between things begun, and things only intended. Our room is small, and there is all the more reason why our Museum should be carefully selected and well arranged. The great point is to have our *local* collections complete; every one in the Society can do something to hasten their completion.

In the Minutes the word 'member' always indicates an existing member of the School, as distinguished from an 'honorary member,' who is generally a Master, and a 'corresponding member,' who is an old Rugbeian. It will thus be seen that several of the Papers of 'members' are printed in full in the Report.

The Finances of the Society are recovering themselves; as will be seen from the balance sheet.

The Secretary regrets that the meetings have been so crowded that he has been unable to produce any statistics of the numbers present.

F. E. KITCHENER.
C. F. ADAM.
J. ARMITAGE.

SOCIETY'S ROOM,
MARCH, 1871.

NATURAL HISTORY SOCIETY'S ACCOUNTS FOR 1870.

Receipts.

				£.	s.	d.
By sale of old Reports				1	17	0
Hon. Members, Dr. Hayman, Mr. Ker				1	0	0
Corr. Member, Mr. Eve, (composition)				0	10	0
Subscriptions, Lent Term, (including arrears)	4	7	6	10	5	0
Ditto, Trinity Term	3	0	0			
Ditto, Advent Term	2	17	6			
				£13	12	0

Expenses.

	£.	s.	d.
Balance due to President	6	10	6
Binding Books, Portfolios, &c.	0	10	11
Anastatic Press	2	0	6
New Reports supplied to Corresponding Members, &c.	0	15	0
	£9	16	11
Balance in President's hand	3	15	1
	£13	12	0

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Treasurer, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any Office is vacant, the Committee do recommend a Member or Associate, or (for the Office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Treasurer form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in his Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition of 10s. for six years.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That there never be more than 20 Members.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members and Associates elected before the passing of Rule XVI. pay a Subscription of 2s. 6d. per Term, and that any Member or Associate who shall at the beginning of any Term be reported by the Treasurer as not having paid his Subscription for the two last Terms be struck off the list of the Society.

XVIII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public Meetings, and receive a copy of the Society's Report.

XIX.

That Associates have the same privileges as Members, except the right of voting at Private Meetings of the Society.

XX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XXI.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

Of Meetings:

XXII.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXIII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIV.

That a Report be printed once a year, or oftener if the Committee think fit.

XXV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXVI.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any name be submitted to the Committee for Membership or Association, or any vote of Suspension or Expulsion passed.

XXVII.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

The following Rules have been passed by the Committee with regard to the Society's Museum.

1. That all keys be collected at the end of each Term by the head Member or Associate in each House, and returned to the President.

2. That any one having lost his key and wishing to have another be required to pay for it.

3. That any one wishing to borrow any book or pamphlet belonging to the Society must first obtain the leave of the President and enter his name in a book provided for the purpose.

LIST OF THE SOCIETY, LENT TERM, 1871.

Officers:

President: Mr. F. E. Kitchener, F.L.S.
Secretary: J. Armitage
Treasurer: C. T. Clough
Editors: The President, the Secretary, and C. F. Adam
Album Keepers: Botanical, C. F. Adam
" " Geological, J. Armitage
" " Entomological, D. A. Ogilvie
" " Zoological, C. F. Adam
Entomological Curator: Mr. A. Sidgwick

Honorary Members:

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. J. E. Smith
Rev. C. Elsee
Dr. Farquharson
Rev. J. Robertson
Mr. Ker

Corresponding Members:

Lord Bishop of Exeter
Dr. Helm
A. C. Bruce
E. P. Knubley, 68
P. Mahony
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H.M. Geological Survey, 67
C. L. Rothera, 68
F. W. Fison, 67
C. S. Taylor, 67
E. Cleminshaw
G. B. Longstaff, 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
J. P. Baynes
W. H. Pike
R. E. Baynes
J. M. Gordon
V. Ellis
G. A. Ogilvie
H. Wilmer
R. F. Boyd
F. R. Smith
W. Sutcliffe
E. W. Prevost
J. L. Boyson
L. Moberly
T. D. Ralli
R. Duff
H. W. Sandars
T. Rivington
J. M. Lester
N. Larden
H. W. Eve, F.C.S. 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H.M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year.

Members:

H. G. Wanton
C. T. Clough
A. Napier
J. Armitage
J. D. Anderson
F. R. Hodgson
C. F. Adam
G. B. Darbishire
R. M. Kennedy
W. B. Lowe
E. A. Burchardt
H. M. Cobb
D. A. Ogilvie
H. R. Ricardo
C. H. Hinton
C. G. Steel

Associates:

M. Goodman
J. E. Higgin
F. Gardner
W. H. Cornish
L. Jeffery
T. H. Lewis
W. Lambert
Meeson
Scholfield
E. T. Wise
W. R. Wise
A. G. Burchardt
A. B. Pearson
T. R. Cross
C. M. Chadwick
F. A. B. Miller
W. S. Higgin
J. G. Adamson
W. S. Jackson
S. Bolton
F. Swanzy
Bence-Jones
J. E. Paul
E. J. Taylor
G. L. King
A. L. W. Sedgefield
E. M. Micholls

LIST OF ILLUSTRATIONS.

PAGE

PLATE I.
Diagrams comparing the Dates of Flowering with the Rainfall and Temperature in 1867, 1868, 1869 9

PLATES II., III., IV.
Sun-spots from drawings by the Rev. T. N. Hutchinson* 20

PLATE V.
Crane's Leg and Diagram drawn by C. H. Hinton 24

PLATE VI.
Sketch of the Sun just before Totality at the late Eclipse by G. M. Seabroke, and copy of sketch by Professor Watson . . 40

PLATE VII.
Diagram for 1870 similar to those in PLATE I. 47

---

* In PLATE III. the penumbra on the right of the spot A at 8 a.m., September 23, has been printed much darker than it was in Mr. Hutchinson's original drawing.

MINUTES OF MEETINGS.

MEETING HELD FEB. 12, 1870:—*Exhibitions:* Chrysalis of Emperor Moth by D. Ogilvie; Branch of Cork Oak (*Quercus suber*) from San Roque, Spain, by C. F. Adam. *Donations:* Casts of Echini from the Chalk, presented by R. Meeson, Esq., F.G.S; Photographs of Arachnoidiscus Ehrenbergii and Pleurosigma formosum, made and presented by T. Higgin, Esq. The thanks of the Society were given to the donors.

A Paper was read by E. Cleminshaw, (corr. member), '*On the Excavations of Kent's Hole Cave,*' giving an account of a recent visit made by the writer to the cave.

MEETING HELD FEB. 26:—*Exhibitions:* Bone-Conglomerate from Suffolk, by D. Ogilvie; Aërolite from railway cutting near Tring, by W. B. Lowe; Models of Pistillate and Staminate Flowers of Melon, made by M. Auzoux, of Paris, by the President.

N. Masterman, (member), then read the following Paper on '*Squirrels.*'

'In offering to read a Paper on Squirrels, I do not intend to go into the subject fully, or give a detailed account of their structure and habits; but simply to relate some points of interest about them that I have noticed at different times myself.

'Last holidays I spent a good deal of time in stalking woodpigeons in a wood,—rather a cold employment, and one which requires a great deal of perseverance and quietness, as if the birds hear the sound of a twig cracking too loudly under one's foot they are off in an instant. But the very nature of this pursuit gave me an excellent opportunity of watching the life of many of the inhabitants of the wood. On one occasion I had the luck to see a fine fox prowling in the wood, who seemed to have left his earth at the further end of it, in order to enjoy the unusually warm rays of the morning sun. He passed slowly by within 15 yards or so of me and never noticed me, as I remained quite still.

'I was especially diverted at these times by the gambols of a tribe of squirrels, (of which there are a great many there,) as though guns are often fired in the wood, the squirrels seem to have learnt that they are never hurt by them; so that far from showing any shyness, they rather annoy one by their audacity, running up a bough a few yards above one's head and barking angrily at the intruder. The noise they make is very remarkable, and sounds just like the crowing of some bird, so that no one would believe it came from a four-footed animal. They have also another cry when much frightened, which is just like the squealing of a miniature pig. So tame were they that they never hid themselves at all, but whenever I went into the wood, came as near as they dared and showed themselves, running up and down the boughs and crowing or barking furiously at me. It is the drollest thing possible to see one darting forwards a yard or two on a bough and then back again with a peculiar sort of spirt, and each time accompanying his rush with a series of these crowings. One morning I saw no less than four all close together on the trunk of a tree, not a yard from the ground, running round and round it. I watched them for some time, and their game always consisted in a chase; one would start off with another after him, and they would bound from fir-tree to fir-tree with wonderful rapidity until they got tired, sometimes running on the ground from one tree to another. While these four were engaged in their game and in crowing to each other, I noticed a fifth making his way from a nest a good way off to join them; he had some very long jumps to make, but he screwed up his courage and got safe across, and then joined the game; so that there were five or six of these lovely little creatures bounding about in every variety of graceful position, and not caring the least for me, though they must have seen me all the while; only when I walked on they stood still for a moment and looked at me, and when I stopped, continued their antics as before. Their leaps were quite surprising, and they kept the upper boughs of the fir-trees in a perpetual state of vibration, so that they seemed to be alive with squirrels; and their motions were sometimes so rapid that the eye could hardly follow them;—altogether it was one of the most beautiful sights I had ever seen. I never went into the wood without seeing one or more of them, and I noticed one point that I have not seen mentioned in any book about them. When they suspected my presence, or had just caught a glimpse of me, they would show their anger by jerking their tails up and down with a peculiar motion, first bringing them up over their backs and then twitching them down again; sometimes they would run forward a little, barking, and then sit up and curl their tails over their backs, waving the tips of them most gracefully while in this position: and I noticed that the motion of the tail was never sideways, like that of other animals, but always up and down. Their motion on the ground was always a sort of gallop or series of leaps, during which the tails were always held straight out, and the squirrel looked just like a small fox. Besides nuts and the seeds of fir-cones, they seem to feed principally on the tender shoots at the tips of fir boughs. Whether they really eat these or only bite them off for fun I don't know, but I have seen a squirrel sitting on the end of a bough biting them off as fast as he could, while fir-tips rained down from him in a perfect shower. But their appetite is very accommodating, and they will eat almost anything in the shape of fruit, leaf, or bark. I had a tame squirrel a short time ago, and used to amuse myself by trying to find something that he would not eat, but I couldn't succeed. He was especially fond of bread and milk, apple, nuts and hips and haws. There are even said to be carniverous sorts. Another odd point about these little creatures is that they seem quite unable to eat with anything like comfort unless they are sitting up, with their tails over their backs. I kept my tame one for some time, during which his graceful ways were a pleasure to everyone, and he got very tame, or rather fearless; for the tameness of a squirrel seems to consist in his not being afraid to bite you, and I never heard of one yet that was so tame as not to use his teeth. At last we gave him to some people living at a village about three miles off, and after they had had him some time he contrived to make his escape, and took up his abode in a tree in their garden, where he built a nest, and they used often to see him running about amongst the branches. Eventually I believe he disappeared.

'The winter nest of a squirrel is a large round ball of moss, sometimes with sticks outside it, but always very thick and warm; in this the squirrel spends the winter, and the young are born in the spring. When first born they are most remarkable little things. I once found a nest of them containing about a dozen little naked dark-skinned creatures, with tails like a mouse, and about the size of a mouse, looking exactly like very small monkeys without fur, and not in the least like their beautiful parents. The squirrel also builds a very light thin nest for summer use, not made of moss, but some lighter substance, such as hay or bass. The fur undergoes a considerable change in winter, becoming much thicker and of a darker colour, while it is only in winter that the ears are decorated with beautiful long tufts of hair. The teeth, like those of all rodents, are very long and sharp, and capable of making a very bad wound on an incautious hand. Their feet and toes are very long and armed with very sharp claws, enabling them to dart up a tree with great rapidity, but causing their movement on the ground to be comparatively slow; so that they always make for the nearest tree when alarmed, and never remain long on the ground. Anyone trying to skin a squirrel will be quite surprised with the great size and strength of the muscles of the hind legs, which enable the little animal to perform such immense leaps.'

MEETING HELD MARCH 12:—*Exhibitions:* Tear-urn discovered by Ismail Bey, in the construction of Malmoodie Canal, Egypt, by H. C. Harrison; Ammonites bildensis, from Whitby, by J. Armitage; Sabine's Snipe, from Wareham, in Dorsetshire, shot and exhibited by T. M. Pike; British remains from Uriconium, by W. S. Jackson; etc.

The Rev. T. N. Hutchinson exhibited various forms of Copper Ore, from Cornwall, Derbyshire, and Lake Superior, and made some remarks on their differences.

D. Ogilvie, (member), read a Paper on '*The Structure of the Horse, as compared with other Animals.*'

Mr. Wilson, (hon. member), made some remarks on the former connection of the Channel Islands with the mainland, suggested by a Paper in "*Nature.*"

MEETING HELD MARCH 26:—This meeting was held at Mr. Kitchener's house for the exhibition of microscopic objects.

MEETING HELD APRIL 9:—Albertite, a bituminous coal from near Brunswick, by Rev. T. N. Hutchinson; Daphne laureola from near Rugby, by the President.

The Rev. T. N. Hutchinson then read a letter contributed by H. N. Larden, corresponding member in the Argentine Republic, in which he gave '*An Account of the* *various Inhabitants of the " Warren " of the " Bizcacha," or Prairie Dog,'* a photograph of which animal was also exhibited, taken by Mr. Larden.

'The inhabitants of the warren are the following:—1. The Bizcacha itself, a curious animal, rather larger than a rabbit, and very stoutly made. After describing its appearance minutely, Mr. Larden mentioned its habit of dragging rubbish of all kinds to form a heap at the mouth of its burrow; its odd mode of running, holding the long bushy tail straight out; its destructiveness to grass, devouring the roots, and leaving the blades to wither; its tameness, its curious barking, and habit of sitting upright on its hind legs close to its hole to watch the intruder. 2. " The Burrowing Owl" *(Athene cunicularia);* their tameness and curious screeching and undulating flight; their habit of coming into houses in the night, where they are often found next morning sitting on the back of a chair. 3. The South American Fox, which resembles the English one, except in its greyer colour and black stripe running down the back; this animal usually inhabits the same burrow with the prairie dog, while the owl prefers to excavate a separate one. 4. The Iguana, which is black and olive green in colour, spotted with white, and grows to the length of three or four feet. It possesses formidable teeth, and when irritated will stand up on its hind legs, and supporting itself on its tail, fly boldly at any opponent. It has also a curious habit of vibrating the tail rapidly as it lies concealed in the long grass. It feeds on locusts, insects, and plover's eggs, and is capable of very great speed. 5. The Spur-winged Plover which lays its eggs in a scoop in the ground like our common Peewit. And, lastly, the Sand-martin and the " Cachilo," a sort of pipit, which dig holes in the roof of the burrow of the Bizcacha.'

F. Bayard then read a Paper on '*Seaweeds,*' dwelling especially on their economical value. The Paper was illustrated by specimens.

MEETING HELD MAY 21:—Sepiola atlantica, a small kind of Cuttle-fish, was exhibited by E. A. Burchardt; the Rev. T. N. Hutchinson exhibited Sepia officinalis, and explained the difference between Sepia and Sepiola.

The thanks of the meeting were voted to Mr. Sidgwick for presenting a large cabinet of British Lepidoptera, and for undertaking to re-arrange the Society's collection in combination with his own. It was determined that a distinct collection of Rugby specimens should be commenced.

Dr. Hayman exhibited and described a set of specimens from Ingleborough Cave.

The President, Mr. Kitchener, read the following Paper on '*The Times of Flowering at Rugby.*'

'In the task of editing the last Report, I had to examine the records made in the various sections. I found that the dates of plants in 1869 had been recorded by F. R. Smith, and others, with considerable care, and as I had often heard the usefulness of such floral calendars called in question, I set myself to see whether our floral calendars for 1867-8-9 gave sufficient data on which I could found a Paper for you. I found that in a considerable number of cases the same plants had been noticed every year, and I saw that I could determine from them with probable accuracy the mean date on which each flowered, and from that infer the day by which we may expect each flower to be in blossom in future years. So that if in any year several of these are after their average or *mean* dates, we may at once say 'the year is backward'; if, on the contrary, they are seen in blossom before the time, we may be able to say at once, 'the spring is early.' It is very often said, 'How backward things are,' but few of us have any reason for saying, except a vague feeling of what we think generally happens at that time of the year. I want to substitute *definiteness* for *vagueness*.

'Of course every new year in which we take a floral list, we shall get more and more near the real average date—provided, that is, we are equally energetic every year.

'Now heretofore our observations have been made only by a few observers, and I am very anxious to have more. As then the number of learned Botanists is small, we printed in the Report for 1869 (p. xii.) a list of the dates at which about one hundred and fifty common plants may be expected, and these plants are given by their common English names so that the list may be serviceable to all members of the Society, whether they know the Latin names or not.*

'A sort of average or *mean* Floral Calendar† having been thus formed, I naturally was led to examine the past year, 1869. From this it appeared that

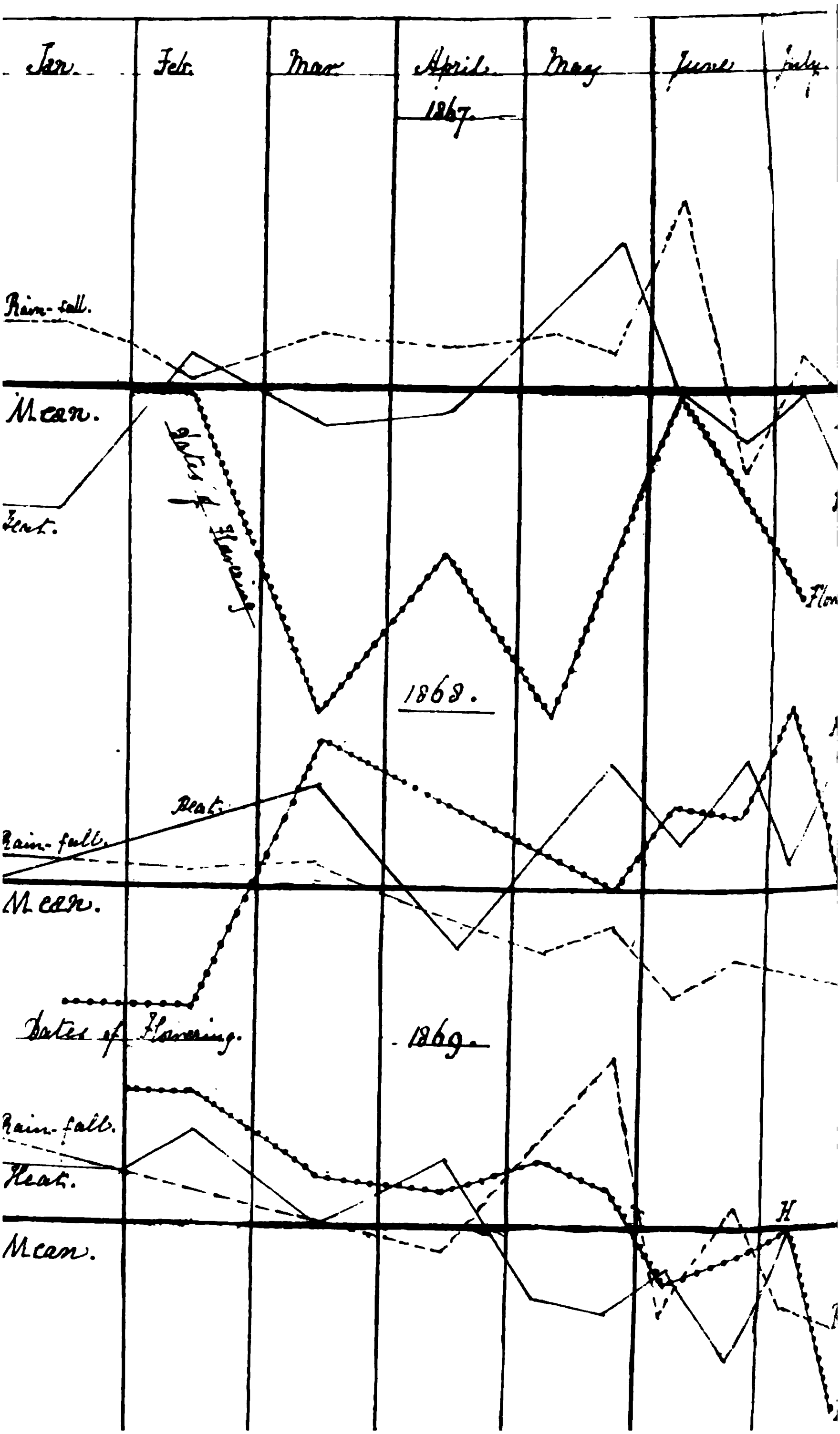
February plants	averaged	6	days	before	the mean date.
March „	„	2		„	„
April „	nearly	1		„	„
May (1st half)	„	3½		„	„
May (2nd half)	„	1¼		„	„
June (1st half)	nearly	3		after	„
June (2nd half)	„	1½		„	„
July (1st half)		at the average			„
July (2nd half)	„	8		after	„

'It will thus be seen that we had a forward Spring, an average May, a late June; the first part of July was of average forwardness, while the latter part became backward. Of course the observations on April, May, and June, are the most reliable, as they are based on a large number of flowers: 37 in April, 45 in May, and 55 in June.

---

* Any member of the School who thinks he has found the earliest flower of any sort, is requested to bring the specimen (with a notice attached to it stating the date and the finder's name) to the Natural History Room, or to the President at his house.

† Part of the Floral Calendars for 1867-8-9-70, compared with the mean Floral Calendar of the four years, will be given at the end of the minutes in the Botanical Report.


Jan.
Feb.
Mar
April.
May
June
July
1867.
Rain-fall.
Mean.
Heat.
Dates of Flowering
Flow
1868.
Heat.
Rain-fall.
Mean.
Dates of Flowering.
1869.
Rain-fall.
Heat.
Mean.
H

'I have tried to represent this in the diagram for 1869 (fig. iii). The thick line in the middle is the *mean* line. The diagram is divided into columns for the months from January to July. I have for greater accuracy considered the first halves of May, June, and July, separately from the latter halves. The dotted line shows the forwardness or backwardness of each month in the dates of *flowering.* If this line rises above the mean line, the vegetation was forward: if it falls below, vegetation was backward. The scale used is ¼ inch to 1 day; thus if the line is 1 quarter of an inch above the middle line in April, it means that the April flowers were 1 day too soon; and so on. You will now be able to trace the state of vegetation in 1869, and by means of the two similar figures (fig. i.) and (fig. ii.) to compare 1869 with the years 1867 and 1868.*

'Here my plan would naturally have ended, but I felt inclined to press it further, and ask why was the spring forward, why was June backward?

'Now the causes which affect the dates of flowering are complex, and include all the peculiarities of our Rugby climate. But two main causes, which vary from year to year, and make the chief differences between one year's climate and another, are easily guessed;—I mean (1) the rainfall, and (2) the temperature.

'Rain and heat together bring on vegetation; rain with cold leaves vegetation at a standstill, and if the rain turn to snow, may retard it; lastly, heat without rain will only be advantageous as long as the earth contains an unexhausted supply of moisture: when the stores of moisture are dried up, heat will be an actual disadvantage. With these rough laws in your mind, I ask you to listen while I tell you what I have been able to do with regard to heat and rain.

'I wanted a curve to tell me whether the rain that fell in each month was above or below the average. When you say that April was wet, you mean wet above other Aprils,

---

* For a very interesting and suggestive naturalist's calendar, I would refer the Society to White's Selborne, p. 369, in our library.

i.e. in our language, above the *mean* of wetness. Luckily for us, Mr. Fuller, of Rugby, has observed the rainfall for 15 years, and was able to supply me with the mean fall of each whole month founded on those 15 years, and therefore enabling us to form a much more reliable mean than our floral mean, inasmuch as observations for 15 years are more reliable than those extending over 3 or 4.* Mr. Fuller also gave the rainfall for every day in 1867, 1868, and 1869, and I was able to construct curves for the rainfall similar to those for the dates of flowering. You will see these in the three figures: the intermittent line indicates by its rise or fall, excess or defect of rainfall. The scale is ¼ inch to 2 inches of rain in the total rainfall of half a month. I give a table of the results from which the curves were made.

	Average	1867	1868	1869
January	1·85	3·09	2·34	3·26
February	1·30	1·42	1·54	2·26
March	1·68	2·57	2·08	1·81
April	1·50	2·37	1·40	1·40
May (1st half)	1·58†	1·30	·07	1·69
May (2nd half)	...	1·09	·46	2·70
June (1st half)	2·38†	3·00	·00	·17
June (2nd half)	...	·25	·26	1·29
July (1st half)	2·31†	1·42	·21	·24
July (2nd half)	...	1·04	·09	·00

'Thus in the year 1869 you will see that the rain or intermittent line is slightly above till middle of March, very much above in May, below in June, and very much below in July. But the rain line alone is not enough—to explain the floral line, we must also get the heat line—and here I should have been at a loss if it had not been for Mr. Hutchinson. Every one knows Mr. Hutchinson's house by the thermometers; these have evidently been kept there from a prophetic yearning on the part of their owner to assist me in this Paper, and therefore he has every morning at 8.30 registered the exact heat by his thermometer. This he has done for 5 years, and I have thus been able to take an average of the heat in every month, based on the last 5 years.

---

* I am sorry to say that Mr. Fuller has ceased this year (1870) to register the rainfall in Rugby, so that one year has been lost. This however throws the onus of registration on us, and I hope the Society will heartily assist Mr. Wilson in carrying out the necessary observations through next year, as a commencement of real observation on our own part.

† The average here given is the average total fall in the *whole* months of May, June, and July.

'The heat table so formed is as follows:

	Average heat at 8.30 a.m.	1867	1868	1869
January . .	37·2 ...	32 ...	37 ...	40
February . .	39·4 ...	40·5 ...	42 ...	43·3
March . . .	36·2 ...	34·8 ...	40·3 ...	36
April . . .	47·5 ...	47 ...	45 ...	50·3
May (1st half)	51·4 ...	57·3 ...	54·5 ...	48
May (2nd half)	53·8 ...	50·2 ...	59·5 ...	50
June (1st half)	57·8 ...	58 ...	59 ...	56
June (2nd half)	58·0 ...	55·7 ...	63 ...	52·5
July (1st half)	60·7 ...	60 ...	61·5 ...	60
July (2nd half)	62·2 ...	57 ...	69·3 ...	65·7

'From this table I was able to make a heat line, the thin line in the figures denoting extra or deficient heat. In the figures a rise of ¼ inch marks an excess of 1° in the daily reading. This average of heat has never been made out before, and has an interest independent of our present subject. A rough glance will shew that on the whole March is colder than either January or February. The sudden advances being between March and April, and again between the second half of May and the first half of June.

'You must remember that these readings do not indicate maxima, but the daily heat at 8.30 a.m. It has been suggested to me by Mr. Symons that the heat should have been measured below the surface of the earth, say 12 inches. But I must plead 'si l'on n'a pas ce que l'on aime, il faut aimer ce que l'on a.' Again, it is by no means clear that three hot days and three cold ones have the same effect as six moderate days, though the average heat of the six days may be the same. But with all allowance for these lines being a very rough guide as to the probable effect upon the times of flowering, I think they are still suggestive. I am afraid any really scientific hearer would tell me that I should have waited longer before publishing my results, but my object being to make use of the Society's floral observations, I may plead the expediency of showing to a young Society that ready labour, as well as ready money, sometimes meets with quick returns.

'You will now see that the floral line in 1869 goes very accurately where we might have expected it to go.

'In February and March the year has extra heat and extra rain,—that means soft showers,—consequently both causes acted together, and the floral line is above both the others.

'In May the rain line is above and the heat line below, we have the rain without heat,—and the result is a retardation of the vegetation—dotted line falls gradually. In June we have again the same thing, and the floral line comes between the rain and heat lines.

'You will find that very often a change in the heat or rain line is followed by the corresponding change in the floral line, not at once, but a little afterwards. If you will consider you will see that this is but natural,—rain and heat are slow causes, and it may be some days before the plants may be got into blossom, the extra rain or heat having given the impetus to the plant's growth, which a little later shows its results in a blossom.

'I have done the same with 1867 and 1868, but I do not think our floral calendars were quite so reliable in 1867,—still you will see some interesting results.

'1868 was an exceptional year. May, June, and July, were very dry: you must remember the heat of July. It only rained six days in May, one day in June, and three days in July, that is, ten days in three months, and between them the rainfall did not come up to half that of one ordinary June or July.

'Luckily rain is of more importance in March and April than in the later months, hence we find the year forward at first, but later on in July we find the plants losing their forwardness, and the July plants are too scorched up to get out.

'I do not rely much on 1867 because it is probable that we did not find the plants so soon the first year; hence the year probably was not so backward as it would appear, that is to say, the flowering line should be parallel to itself but higher. Still I have not liked to 'cook' the results: I give them you exactly as they came. This reminds me to call the attention of observers to be very careful when they mark a date to see whether the plant is only just out, or whether any blossoms are already over. In that case put a 'by' before the date in the record.

'You will see that the spring of 1867 is unexpectedly late, the floral line is nowhere, notwithstanding that the heat and rain were rather above than below the average. I was much astonished by this, because I thought some one, say Mr. Wilson, would be sure to call attention to the discrepancy. But it struck me to refer to Mr. Fuller's register for something to account for this retardation, and there I find that on the 10th of March we had frost to cut off all the young shoots which the mild weather had called forth, and more than that, snow fell on the 18th, the 19th, and again on the 21st of March. Hence the year hardly got over the rough treatment its young efforts got in March till well into May, when the extra heat and rain continued through the latter half of May drew the year up to nearly an average. The end of June, however, was both dry and cold, and the year hardly ever gets to an average state of forwardness.

'I now leave this subject—I am afraid I have been rather tedious, but I was anxious to show you that our floral calendar may be made of use, and that if we continue it for many years, we may really be able to get some insight into the effects of weather on plants.

'There is another use in the calendar, which I anticipate.

It is of the greatest importance to know as far as we can any physiological facts connected with special species and special varieties. Why so? Because the great botanical problem at present is to find the adaptation of the special characteristics of each species or variety to the special needs of that same variety. And any facts that we can establish which differentiate one species from another in such a physiological matter as dates of flowering, may be of importance.

'Thus, for instance, we begin to see the order in which the buttercups come out. As far as our observations have gone, invariably we have the figwort first of our yellow buttercups, the wood buttercup second, the bulbous and upright say bracketed third, and the creeping buttercup last of the set except the corn.* Now these buttercups differ very little *inter se*. Why this difference?'

MEETING HELD JUNE 4:—*Exhibitions:* Branches of Cytisus Adami,† showing the three varieties on the same stem; and living specimens of Man Orchis, Fly Orchis, and Orchis fusca, from Kent, by the President; Monstrous form of Scilla nutans, forming a dense spike instead of a raceme, by the Rev. T. N. Hutchinson.

Mr. Kitchener exhibited specimens of Ustilago antherarum attacking the flowers of a pistillate White Lychnis, and apparently producing the growth of the generally rudimentary stamens.

Mr. Wilson exhibited the roots of a yew-tree, which in

---

[*] Since the above was written I have received the first instalment of the new Marlborough Flora. I cannot help noticing that these plants succeed one another in the same order at Marlborough, viz., figwort in February, wood about April 8th, bulbous April 12th, upright April 19th, creeping April 24th, corn May.

[†] See the Natural History Society's Report for 1868, p. 35.

order to reach the water at the bottom of a well, had sent down roots hanging loosely *in the air* to the depth of 14 feet.

The thanks of the Society were voted to T. Higgin, Esq., for a present of micro-photographs.*

The Rev. J. Robertson, (hon. mem.) gave a lecture on the structure of the Blow Fly and other Insects, illustrative of the photographs presented by Mr. Higgin.

MEETING HELD JUNE 18:—*Donation:* Lepidoptera from Turkey by B. R. Wise.

N. Masterman (member), read a Paper on '*Grebes,*' exhibiting a specimen of the Eared Grebe, and eggs and breast-feather of the Crested Grebe taken in Wiltshire this year.

MEETING HELD JULY 9:—*Exhibitions:* Gold Sand from Australia, and Ruby Sand from New Zealand, by the Rev. T. N. Hutchinson; Flower of Tulip Tree (Liriodendron tulipifera), by E. T. Wise; Goat Moth Caterpillars in Wood, by S. F. Green.

The following account of observations on '*Asparagus Beetles,*' carried out by B. E. Wise, (Associate of the Society), was then read by Mr. Wilson:—

'These beetles, some of which I exhibit, are, I believe, of rather rare occurrence. Certainly I have never seen them on asparagus till last year, and then they were very abundant. They lay their eggs on the stem, standing out from it like short thick hairs, and the whole metamorphosis from egg to beetle is gone through apparently in the same season. The grubs are brown, the beetles red and black and white, so as to be very conspicuous. I wished therefore to ascertain whether they were rejected by birds, as a test of Wallace's theory that conspicuous creatures, lacking the protection of obscure colouring, are compensated for it in some other way, as by disagreeable taste.

---

* For a list of these see end of the Minutes.

'I therefore requested Benham to experiment on his young and inexperienced jackdaw. He gave it both grubs and beetles, and it ate them at first, and then systematically declined. The taste was evidently objectionable.

'I then requested B. E. Wise to repeat the experiment with some fowls. He informs me that the chickens ate the grubs with the greatest avidity; and that then he tried the beetles. The chickens ate them, with the approval, and sanctioned by the example of their mother; but they did not seem to like them, and soon fell ill; and the owner of the fowls prudently declined to allow the experiments to be continued.'

F. C. Bayard, (member), read a Paper on '*Bird's-nests*,' being chiefly based on an article on the same subject by Mr. Wallace.

The thanks of the Society were given to Mr. Swanzy, of Lee, Kent, for a valuable collection of typical species of Beetles, from the Gold Coast of Africa.

MEETING HELD JULY 16:—*Exhibition:* Emperor Moth, by B. R. Wise. *Donation:* Collection of Insects illustrating *Protective Mimicry* by their resemblance to sticks and leaves, by J. M. Wilson, Esq.

Dr. Farquharson, (hon. mem.), then read a Paper on '*Sleep*.'

Professor Corfield then gave an interesting account of '*An Ascent of Mount Etna in the Winter*,' at which time of year the mountain is seldom ascended.

PRIVATE MEETING HELD JULY 18:—Alterations in the laws, (1) that place in the School be no longer a bar to Membership in the Society; (2) that any Member not reading a Paper once a year be degraded to the rank of Associate. This was the last Meeting of the Summer Term.

MEETING HELD OCT. 1:—*Exhibitions*: Cuscuta hassiaca, (from a field of lucerne on Mr. Edmunds' farm on the Barby Road), by the President; Comma Butterfly (Vanessa C. album), a Rugby specimen, by H. N. Hutchinson; Fossil Shark's Teeth, by S. F. Green; Ammonites bifrons (Whitby), by J. Armitage.

Mr. Sidgwick, (hon. mem.), read the following Note on '*The position when at rest of Chalk-hill Blues.*'

'On the 13th August, 1870, I noticed on the road from Bex to Gryon, in the Rhone valley, a large number of the Chalk-hill Blue, (Polyommatus Corydon), on the umbelliferous plants by the roadside. It was just sunset, and they were all at rest. Their colour and shape so effectually protected them from notice, that even when I said to our driver, 'There are four butterflies on that plant,' he could not see them, at a distance of only about 10 feet. I got out and plucked them off and threw them into the air; and the good man's puzzled wonder was amusing to witness.

'Besides the colour, (a pale ashy grey, like the stones, and the flowers of the plant,) they were concealed I think by their shape. I noticed that they all rested *head downwards.* It occurred to me that even this apparently trifling detail of instinct or habit might be protective. The eye in wandering over a plant is arrested more easily than one would suppose by any outline *out of accord* with the general lines on which the plant is constructed. Now all plants grow with their flowers and leaves and shoots pullulating or radiating upwards. Into this scheme the position actually adopted* (fig. 1.) fits excellently, while the seemingly more natural position (fig. 2) is in sharp antagonism to it. In short, butterfly (no. 2) would be more easily seen and devoured by its foes, while butterfly (no. 1) escapes certainly a human eye ten feet off.'

The Rev. T. N. Hutchinson gave some observations on the changes in shape in the late Sun-spots.†

The President then read a Report of the *Experiments of Dr. Brown-Sequard on Guinea-pigs,* as narrated by him in a Paper on '*The Inheritance of Abnormal Structures,*' read before the British Association at Liverpool.

MEETING HELD OCT. 15:—*Exhibitions:* Young of Grass Snake, by Mr. Robertson; Gold Quartz from Australia, by E. J. Wise. *Donations:* Box of British Lepidoptera, caught and presented by W. C. Marshall, (corr. mem.); Second Set of Micro-photographs, by T. Higgin, Esq.; Bottle of Atlantic Ooze, brought up in H.M.S. *Porcupine,* from a depth of three miles, by W. G. Stobart, (O.R.) Thanks were ordered to be returned to the donors.

Mr. Kitchener exhibited and described a double variety of Anemone Pulsatilla, found on Newmarket Heath.

Mr. Wilson exhibited and remarked on the following specimens collected this summer: Oolite from Skye, near Portree, Petrified Moss from Prince Charles' Cave, Skye, Vitrified Fort from near Dingwall, Hypersthene from the Cuchullins, Skye.

---

* For these figures, drawn by H. R. Ricardo, (member), see plate v. facing p. 24.

† See p. 19.

J. Armitage (member) exhibited and described the three species of *Geum* found near Rugby, showing the special characteristics of G. intermedium lately discovered by him at Coombe.

Mr. Sidgwick then gave some advice to collectors as to '*The Method of Digging for Pupæ,*' from which the following hints are extracted:

'Choose solitary trees, not trees in woods nor trees in hedgerows. The biggest trees are the best.

'Don't dig deep, an inch or inch-and-a-half from the surface being sufficient.

'Trees in places liable to be flooded are said to be bad, [but this subsequent experience leads me to doubt].

'Choose any holes where the tree overhangs, or where the roots have rotted away.

'If the tree comes vertically down to the ground on one side, and slopes gradually on the other, try the vertical side.

'Especially examine grass tufts growing out of the roots.

'A putty-knife or a garden trowel are excellent things to dig with.

'The largest number I have taken from one tree this season is 33, and that tree is —— somewhere in the county of Warwick.'

The Rev. T. N. Hutchinson then described a fine *Sun-spot* that had been visible in September, illustrating his remarks by a series of Indian-ink drawings.

'A remarkably fine sun-spot, or rather group of spots, was visible during the latter part of September, and as the weather was particularly fine I was able to make some careful drawings of it. These are shewn on a reduced scale in plates ii. iii. and iv.

'The instrument used was a 4½inch silver-glass reflector of 5ft. focal length, and the powers were 80 and 100.

'The spot A must have come into sight about the 17th or

18th of September, but I did not happen to observe it till the 21st, when it presented the appearance of an elongated spot with two fine luminous bridges springing from the northern end. (Plate ii).

'By the next day the spot shewed a tendency to divide into two by narrowing at the centre, the two luminous bridges still remaining conspicuous, though altered in form. On the 23rd the division was almost complete. At this time the northernmost portion presented a very striking appearance, one of the bridges being of dazzling brightness, suggesting the idea of metallic silver.

'On the 24th the division was complete, each umbra being again subdivided by a luminous bridge.

'I sketched it again on the 28th and 29th, when the two principal umbræ had become still further separated. Soon after this it disappeared from the western limb.

'The penumbra at its greatest must have covered a space of about 70,000 miles by 50,000, not including the outlying group of smaller spots shewn in the drawings, two of which situated in the south-east had been conspicuous throughout.

'NOTE BY MR. HUTCHINSON, DECEMBER, 1870.

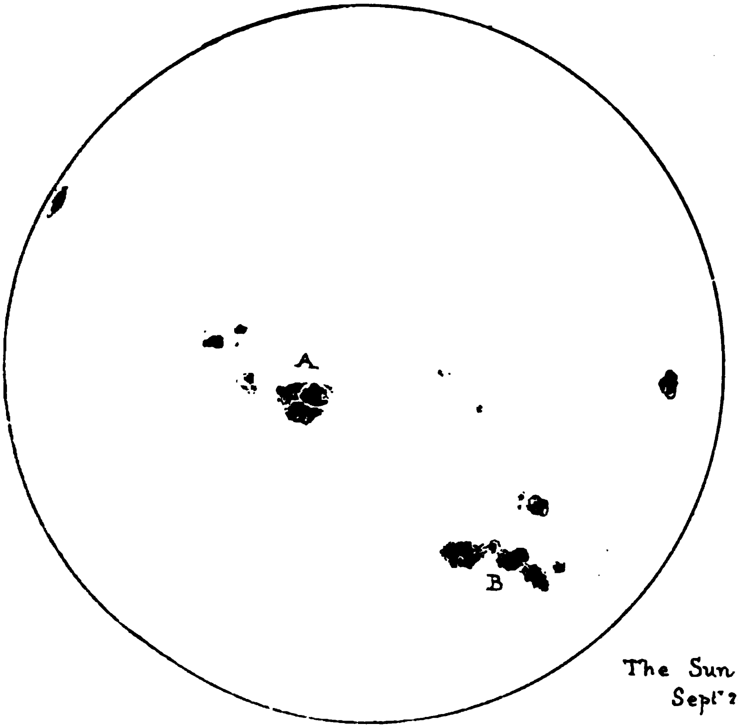
'Owing to unfavourable weather I was only able to get a glimpse of the group upon its first reappearance at the eastern limb of the sun.

'I recognised however the four separate umbræ, though divested of the greater porton of the penumbral markings that had previously surrounded the group.

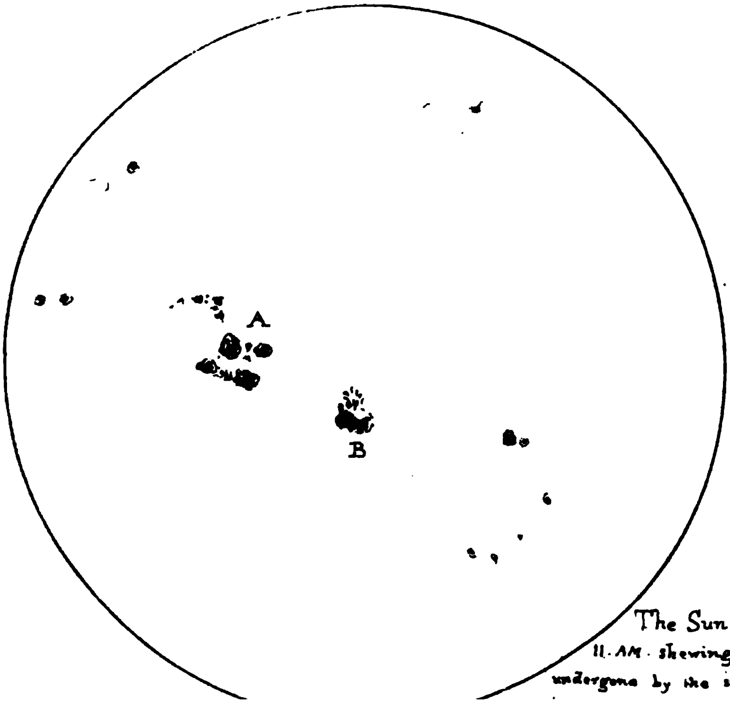
'On the 21st of October I was able to make a careful drawing. The lower figure in plate ii. shews the entire disc, and plate iv. the detail of the group. In plate ii. I have placed side by side the views of the solar disc taken on September 24th and October 21st, as the sun had made a complete rotation during the interval, and it is interesting to mark the changes that the groups on its surface had undergone.

'It will be seen that the two principal groups *A* and *B* had approached each other, the former having had its four umbræ more widely separated, while the group *B* had contracted considerably.

Plate II

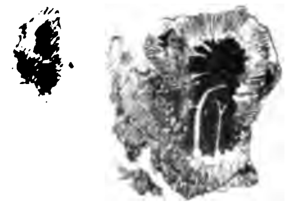


The Sun
Septr 24th 1870
8 AM.

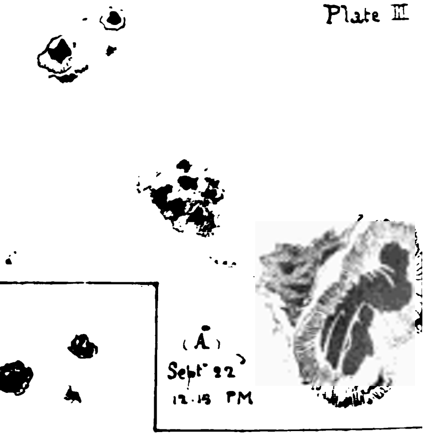


The Sun Octr 21st 187
11. AM. shewing the changes
undergone by the spots during th

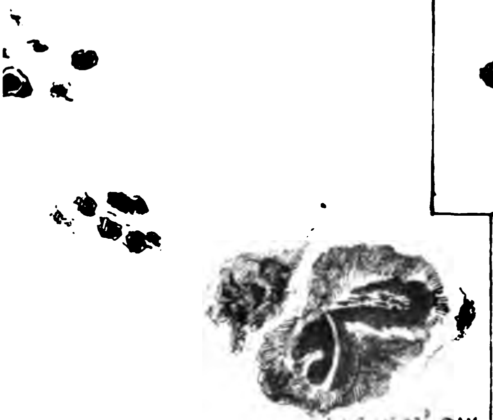
Plate III



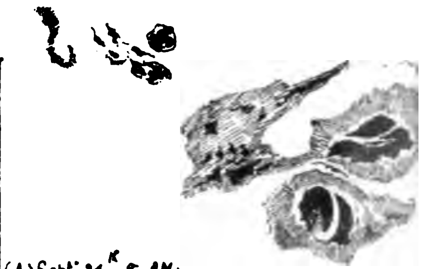
(Spot A)
Sept 21st 1870
12.18 PM



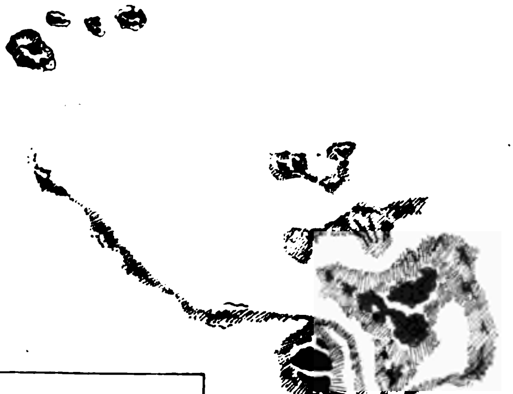
(A)
Sept 22
12.15 PM



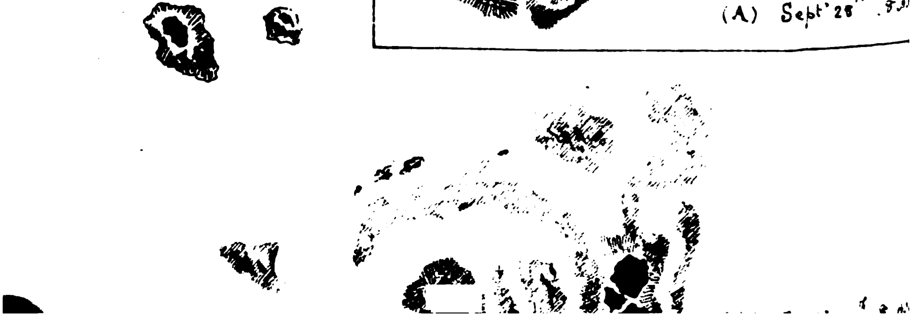
(A) Sept 23 8 AM.



(A) Sept 24th 8 AM.



(A) Sept 28th . 8 M



'It will be remembered that magnificent displays of Aurora Borealis took place on the evenings of the 24th and 25th of October, and I turned my telescope to the sun on the morning of the 25th, rather expecting to find that some marked changes had taken place on the solar disc. No striking outbursts, however, had occurred, although there had been considerable activity in the group of small spots south of the four umbræ, as will be seen from the drawings. (Plate iv).

'Plate iv. also shews the very pretty spot (B) nearly central on October 21st.

'The next is a fine spot sketched on December 17th. Upon measuring it with a parallel wire micrometer I found the larger penumbra to cover a space of more than 30,000 miles by 21,000.

'The last sketch in plate iv. shews the fine group of spots on the sun at the time of the partial eclipse on December 22nd. The sketch was not made till the following day, but no material change had taken place meanwhile.

'During the eclipse I watched the progress of the dark body of the moon across the spots with great attention, but I was unable to distinguish the slightest difference of shade between them.'

MEETING HELD OCTOBER 29:—*Exhibitions:* Carduus Marianus from Leicester Arches, (new locality), by E. Wise; Malformation in Sparrow's Egg, by C. M. Chadwick; Puss Moths, Caterpillars, and Chrysalids, by H. A. Bull; Photographs of the Sun taken at the Kew Observatory by Professor Balfour Stewart on September 21, 22, 23, 24, and 26, marking the progress of a great Solar Spot; and presented by him to the Society through Mr. Wilson.

Mr. Wilson then read the following Note on '*The Aurora Borealis of October* 24, 1870.'

'On the evenings of October 24 and 25 there were splendid displays of the Aurora Borealis, probably finer than have ever been recorded in this country. It most nearly resembles one described by Roger Cotes as observed at Cambridge on March 6, 1715. It was exceptional from the brilliancy of the colouring, and from the extent of it, the whole even of the southern horizon being tinged with deep red, and large masses of colour being seen to the north, east, and west. It was also exceptional from the clearness with which the point of convergence of the rays was marked on both nights. At times the focus was occupied by brilliant white light. The point was near η Pegasi at 8.30 on the 24th, which gives a point 22° or 23° from the zenith, and about 5° east of south. On the 25th the point was between ζ and ϵ Cygni at 6.30, which would be 8° from the zenith, and 1° east of south. On the 24th therefore the auroral rays were nearly but not accurately parallel to the direction of the freely suspended magnet.

'It is specially to be noticed that the most splendid auroras have been seen at this time of year. The greatest auroras of this century were on October 23, 1804, October 24, 1847, and October 24 and 25, 1870. This indicates a cosmical rather than a terrestrial origin to auroras as well as to meteors.

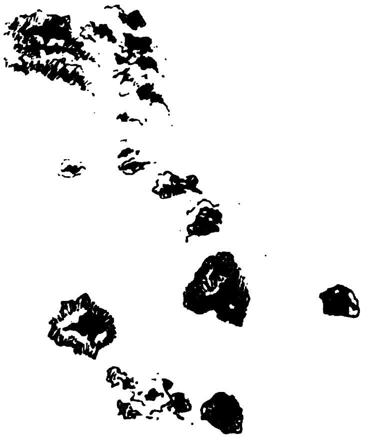
'Mr. Seabroke and I made some observations of the light with my hand spectroscope of the Browning-Herschel pattern. The slit had to be made wide in order to obtain enough light. There was one bright broad band which must have been near D, but nearer the green, and three others, easily visible, which lay between F and E, by estimation. Even in looking at the reddest part of the aurora no lines were visible towards the red end of the spectrum, but this was probably owing to the imperfection of the instrument for such an observation.

'It is satisfactory to record that the phenomenon was thoroughly well observed by the school, nearly every one having been aware of it, and having been out to witness it.'

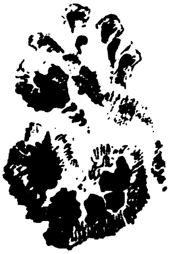
Mr. Hutchinson, with a small direct-vision spectroscope, had seen in addition a faint band in the red. He also men-

Plate IV.

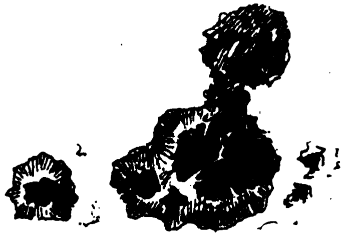
Spot A Octr 21st 1870
11.45 AM



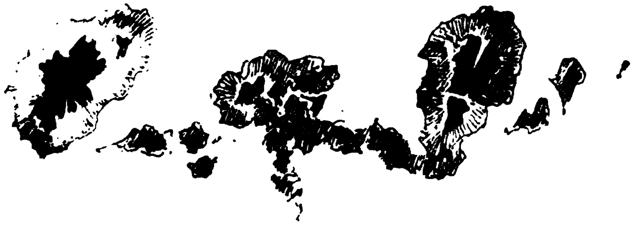
Spot A Octr 25th 1870
11.45 AM



Spot B.
Octr 21st 1870
1 PM



Sun spot Dec 17.
1. PM



tioned that the yellow line was not found in the spectrum of any known gas.

Mr. Hutchinson then read a Paper on '*Diamonds*,' illustrating the subject by numerous beautiful models in glass of the best known diamonds; amongst these were the 'Great Nizam,' the 'Star of the South,' the 'Koh-i-noor,' the 'Regent,' and the 'Great Mogul.'

MEETING HELD NOV. 12:—*Exhibitions:* Plagiostoma spinosum, Echinus ovatus, from Maidstone, by W. B. Lowe.

Mr. Hutchinson exhibited some further drawings of Sun-spots, (see p. 20).

A letter was read stating the progress made in the rearrangement of the collection of Lepidoptera in the cabinet presented by Mr. Sidgwick.

MEETING HELD NOV. 26:—*Exhibitions:* Prize Collection of Rugby Fossils presented to the Arnold Library by O. Leggatt; empty cocoon of Sphecia apiformis, by W. C. Marshall.

R. M. Kennedy read a Paper on '*The Mount Cenis Tunnel.*'

C. H. Hinton, (member), read the following Paper on '*The Mechanism of a Crane's Leg.*'

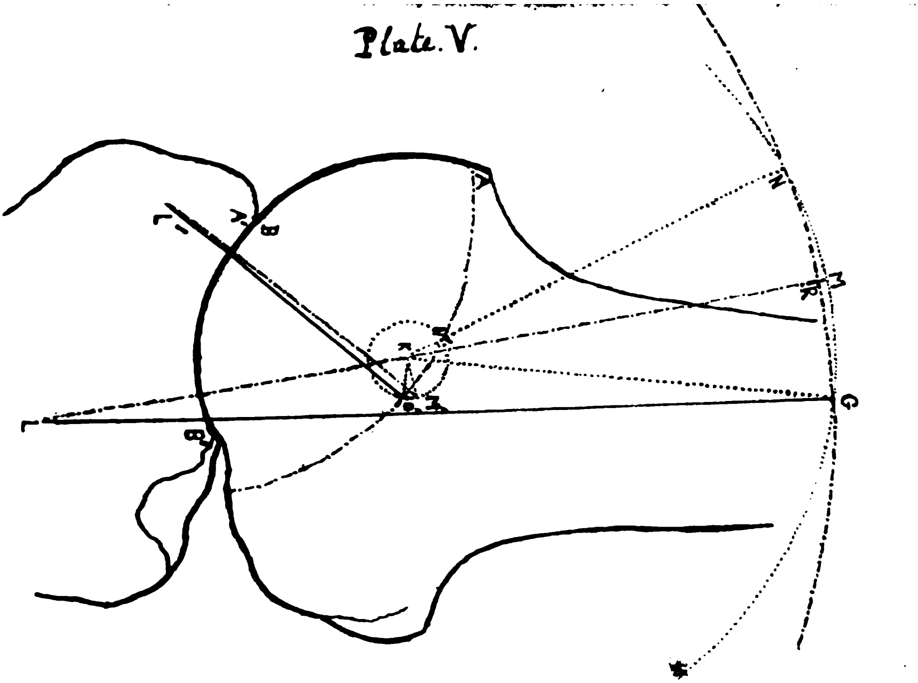
'Storks, cranes, herons, and flamingoes all have a very singular habit, which is one of the greatest peculiarities of this class of birds. They are accustomed to pass the greatest portion of their lives standing on one leg. Why they should do so is not very evident; perhaps, as they frequent marshes and stagnant pools and have the lower part of their legs very often under water, they like to keep one of these dry and warm if possible, and relieve guard when the other gets too cold. But whatever may be the use of the crane's standing on one leg, that it does so is certain, and how it manages to do so I hope, by the aid of some diagrams* kindly lent to me by Mr. Tupper, to be able to make clear.

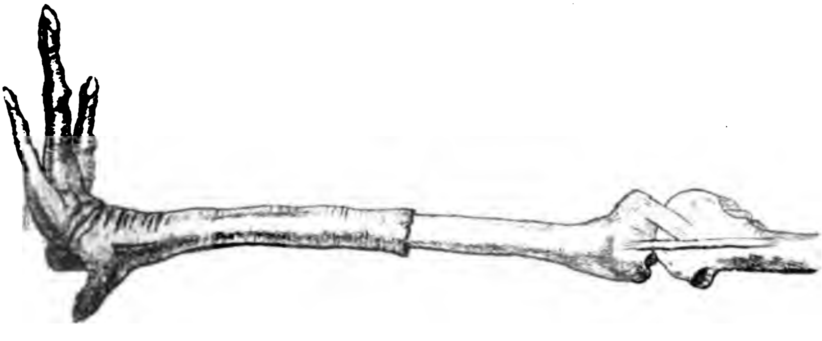
'It would not do for the crane to trust to muscular power for keeping its balance, because it goes to sleep on one leg, and, since voluntary control over the muscles is lost in sleep, it would find itself on its beak in the mud every time it dozed off. Besides, the legs of the crane are so slender that even if muscles were capable of the desired object, there is not room for them. Even we with our thick legs find it a considerable strain to stand on one leg for any length of time. But although in this respect we can reason about the crane's habit from our own experience, yet if we want to understand it thoroughly, it must be premised that a crane's leg is very different from a man's. Man differs from most other animals in having his limbs farther projected from his body than their's are. The crane is no exception; the middle joint of its leg corresponds not to our knee but to our ankle; it is the uppermost joint in fig. I.: the joint that corresponds to our knee is just within the body of the bird. The "foot" of the bird consists of three toes, the joint whence they spring corresponds to the joints by which the toes are attached to the foot; thus the whole leg of the crane represented in fig. I. from the uppermost joint downwards corresponds to our foot. Suppose now a crane standing upright on one leg, the toes spread out, and the whole of the lower joint partially or entirely buried in the mud, this part of the foot would not be likely to yield so as to disturb the balance of the bird, and the uppermost joint being close to the body and surrounded by a great deal of muscular and tendinous matter would likewise be sufficiently stable. So all depends on the joint in the

---

* See plate v., where the drawings to illustrate this Paper were prepared for Anastatic printing by C. H. Hinton.

Plate. V.





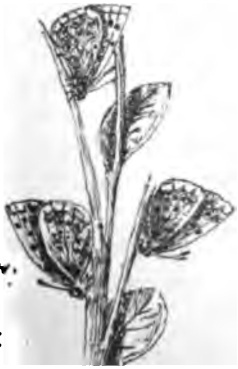


Fig 1

Butterfly;
head downwards.
(as they do sit)
see page 17.

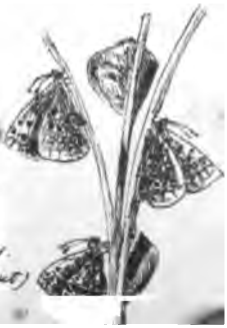


Fig 2

Butterfly;
head upwards.
(as they do not sit)

middle of the leg. This, as we have seen before, corresponds to our ankle, and the lower part of the leg to our foot; but to our foot in what position? Not as it ordinarily is, at right angles to the leg, but forming nearly a straight line with it, just as if we were to extend the foot as far as we could and stand on tiptoe. If our feet were naturally in this position we could not bend them back any farther; no more can the crane, for the bone of the heel, the os calcis, obstructs. So it is evident that there is a likelihood of the joint bending in two directions only, forwards or sideways. It is prevented from bending sideways by strong bindings of a very lowly organized structure, the lateral ligaments; but why the joint should not yield in a forward direction when the bird is standing upright is a question of a much more delicate nature, for if all power of bending its leg forwards at this joint were taken away from the crane it would be in a pitiable condition. The problem nature has solved in the crane's leg is this. Required a contrivance for hindering, nay, absolutely preventing slight forward motions of the joint without impairing the utility, power, and beauty of the limb.

'In the lower of the diagrams in plate v., a crane's leg is represented with everything dissected away from the joint of which we speak, except the ligaments. These ligaments may be considered as bands of very strong elastic stretching across the joint; their direction and action are more exactly exemplified by the lines LG L′G′ in the upper figure (plate v.,) L, G, L′, G′ being points at which the ligaments are inserted into the bone. These points move with the bone; the joint on which the upper bone moves is a semi-cylindrical hinge, the surface from A to B working when the joint is bent along the surface A′B′. The center of motion of the upper bone is at K; round it any point on the bone describes an arc of a circle when the joint bends;—thus the point G′ tends to go in the circumference of the circle G′M′N′, the point G to go in the circle GMN. Consider now the action of the longer ligament when the joint bends, that is, if the bird tends to fall forwards: the point G being part of the bone describes a portion of the circumference of a circle round K, that is, it moves along GMN, and the ligament is carried along with it, its upper point of attachment. But the ligament is also attached to the point L, supposed motionless, and so G can only move, without stretching the ligament, in a circle with L for center, that is, in the circle GRN.

'Let us now trace what happens when the bone moves forward; the point G, as part of the bone, moves in the arc GMN; this arc lies without the arc GRN, which expresses the utmost range of the unstretched ligament. From this it is evident that, for the joint to bend the ligament must be stretched, the amount of stretching being indicated by the line RM. So all slight forward motions of the joint are prevented, while, if the crane wants to bend its joint, it can easily, by the exertion of muscular force, overcome the resistance which the ligament exerts up to the point M. After M the elasticity of the ligament, instead of resisting the flexion of the leg, favours it by just as much as it had before resisted it, and after N the ligament ceases to influence the motion of the leg at all. Thus from G to M the long ligament tends to prevent flexion of the leg, from M to N it assists it, and after that point it has no effect at all.

'The only respect in which this arrangement does not seem quite satisfactory is in point of strength. The resistance it affords to the bending of the leg does not seem quite great enough to keep the crane upright under any very trying circumstances. But this is compensated for by an auxiliary ligament, which acts on just the same principle but in a different position. This is the short slanting ligament in the lower figure, represented in the upper by the line L′G′. Its points of attachment are L′ and G′. As the bone bends the upper point of attachment is taken in the circle GRS, while the ligament without stretching could only move in the circle GRP. Thus when the joint begins to bend, this ligament is stretched like the other, and therefore cooperates with it to prevent the flexion of the joint. This ligament, like the other, after it has resisted the bone for a certain distance in its forward motion, assists it by just as much as it before resisted it. To speak accurately, the longer ligament acts as a check on the flexion of the bone for an inclination of about 22°, the shorter one for a rather greater angle.'

Dr. Farquharson read the following Paper on '*Trichina Spiralis*.'

'The subject of parasites is one with which we have all a certain amount of practical familiarity, for few among us can have escaped the annoyance occasioned by the more superficial creatures of this class. But if we direct our studies a little deeper, we perceive that when the internal organs became tenanted by these intruders, the gravest consequences may ensue, and heavy losses be experienced by the proprietors of animals thus affected. Thus, while the bite of a flea or a mosquito is a mere source of temporary irritation, the presence of entozoa in the kidney, brain, or liver, almost inevitably brings about a fatal result.

'In Iceland large numbers of the inhabitants die from what are called hydatids in those two latter organs, and the sturdy or staggers, as well as the rot in sheep arising from parasitic infection, are well known and dreaded by agriculturists. I am not, however, going to draw your attention to any of these interesting points at present, but intend to speak for a few minutes about the trichina spiralis, whose history and migrations have been very fully worked out by scientific observers during later years. Now, considering the facility with which it is now detected, it seems strange that its existence was so long unnoticed, for although Tidemann of Germany observed what he called stoney concretions in the muscles more than half a century ago, it is only within the last thirty years that their true nature has been ascertained. To Mr. Paget, the eminent surgeon, belongs the absolute credit of priority, while Messrs. Hilton, Owen, and Cobbold are entitled to shares very fairly apportioned in the last-named gentleman's exhaustive work on 'Entozoa.' The portion of animal substance selected by the trichina for its permanent restingplace is not picked out at haphazard, and we never find it, save temporarily, anywhere else but among the muscles. On examining a piece of the affected tissue we find it to present a sort of greyish or mouldy appearance, as though it had been sprinkled with dust or small eggs, which cannot be scraped off. On looking a little more closely an experienced eye may clear up this into a multitude of small cysts or separate masses, but it is only by microscopic examination that the whole mystery is finally elucidated. We now discover each of these indistinct specks to be a regularly-formed lemon or shuttle-shaped case, sometimes transparent, but more usually quite opaque from the deposition of calcareous salts in its walls. A little acid, however, assists our vision in peering into the interior, and there we find snugly coiled up, like a terrier dog lying on a rug, a little worm about $\frac{1}{25}$ of an inch in length and $\frac{1}{530}$ in its transverse diameter. On releasing it from what we may either look upon as its prison or its castle, we may sometimes observe it to move languidly, as though trying to stretch itself, but if its period of residence has been more prolonged life is probably extinct.

'On going a little into its structure we find a thick external integment, after which we come to several layers of differently-directed muscular layers, and a well-formed intestinal tube with oval aperture. In the female we find an oviduct filled with large numbers of eggs, which form the most dangerous feature in the life drama of this apparently insignificant creature. The walls of its abode are formed of concentric laminæ, consisting of some albuminous material and degenerated muscular fibre, and vary from the $\frac{1}{750}$ to the $\frac{1}{1500}$ of an inch in thickness.

'Of course the number of trichinæ present in the person of any one 'host' is a matter of mere conjecture, but it has been ascertained on one occasion that the muscles of a cat contained 325,000 per ounce, from which Dr. Cobbold draws the startling conclusion that a single* human being may readily harbour 30 millions of these unwelcome intruders.

'We have seen that their habitat is confined exclusively to the flesh or muscular tissue, but a more curious point is that the process of selection goes further and decides that they should only be met with in the purely voluntary fibres.

---

* An ordinary man weighing 10 stone carries about 4 of muscle.

Now you are, of course, aware that over our ordinary superficial muscles we have complete and absolute control, whilst those forming the structure of the stomach, intestines, and other internal organs, perform their duties under the guidance of the nervous system; and the anatomical difference between these two varieties roughly is, that whilst the voluntary fibre has a very beautiful arrangement of transverse striæ or cross bars, the involuntary is composed of flattened bands without any such distinctive appearance. The reason for this preference on the part of the trichina is quite unknown, but that it has something to do with the presence of transverse striæ is rendered probable by the fact, that although the heart is an involuntary muscle, it possesses these markings, and accordingly has now and then been known to suffer from the intrusion of the parasite.

'Were our vital structures more frequently attacked, their functions must inevitably be embarrassed to such an extent as to extinguish life, and we must therefore regard the limitation of the trichina's intrusion as a truly beneficent law.

'But having examined into the nature of its abode, let us now try and find out how it gets there; and to do this we must write a species of brief biographical sketch, and study its history from the cradle to the grave.

'Let us therefore suppose that some unfortunate animal has consumed a portion of infested flesh, and that a certain number of cysts have been thus introduced into its stomach. The gastric juice dissolving the calcareous envelope liberates the worm, which, although only in a larval or baby condition while encapsuled, after a residence of two days in the intestinal canal, becomes mature: eggs are now produced in large numbers, which on the sixth day are born without their shell. The mother having fulfilled her destiny, expires, and the orphan brood, compelled to shift for themselves, pierce the intestines with their sharp mouths, and escaping through the cellular tissue in all directions, finally reach the muscles which they have selected for their future abode. Fourteen days is now sufficient for them to acquire the form and development of the adult worm, and forming—I was almost going to say, spinning—around themselves a sort of cocoon, they settle down to await the further progress of events. It must be obvious to you that, if undisturbed, they are unable to escape from the stoney investment which surrounds them, and in course of time gradually die of starvation. Earthy matter is now deposited both in and around their bodies, they shrivel up, break into fragments, and eventually the whole cavity of their coffin is filled by an indistinguishable mass of carbonate of lime. If, on the other hand, some friendly stomach releases them from captivity, we have seen the—to them—more satisfactory termination of a career which in no case is free from a certain amount of romance. Now of course all this has not been traced without much labour, and experimental research has been pushed to its extreme limits in settling the various points we have just been discussing. Dr. Cobbold has taken a prominent part in these investigations, and I here transcribe some of the details from the appendix to his important work:

"'On the 20th March, and again on the 21st (1865), feedings were administered to a hedgehog. On the 20th April the animal seemed to be attacked with symptoms of trichinosis. It refused food, kept its head extended and the eyelids closed. On the 27th it seemed worse, and on the morning of the 28th it was found dead. On the 29th I examined the flesh and found abundance of living trichinæ in the muscles. The capsules were very thin and transparent.

"'On the 1st and 2nd of May portions of the left fore extremity of this animal were administered to a cat. It eat the flesh very readily, consuming the entire limb. On the 15th of the following June the cat was killed, when living trichinæ were found within all the muscles which were examined.

"'Out of 16 experiments 7 failed, they being 3 sheep, 2 dogs, 1 pig, and 1 mouse.

"'The successful were 4 dogs, 2 cats, 1 pig, 1 guinea pig, and 1 hedgehog.

"'Therefore carnivorous animals and those subsisting on a mixed diet appear to be most liable to entertain trichinæ. Experiments on birds always failed.

"'Feedings were administered to a chicken and goose respectively. These birds were destroyed some months afterwards and sent to me for examination; but the most careful scrutiny failed to detect any trichinæ within their muscles. The goose was cooked and eaten without the slightest hesitation. The chicken I found too tough for consumption.'

'It is therefore satisfactory to observe that our most usually edible animals are not liable to be thus infected, and we see at the same time the possible dangers attending the introduction for experiment or necessity of too great a variety of creatures into our bill of fare.

'Hitherto we have regarded trichinæ only as a pathological curiosity. Let us now consider in how far its presence makes itself known to its bearer during life. Professor Owen was the first to throw out hints in this direction, and thus wrote in the Cyclopædia of Anatomy and Physiology:

"'The cases which had occurred before the publication of the first description of this entozoon, led me to conceive that although the species was of so minute a size, yet the number of individuals infesting the body was so immense and their distribution throughout the muscular system so extensive, that they might occasion debility from the quantity of nutriment required for their support.'

'This opinion he abandoned on account of cases having occurred in 1836 in which an infected subject enjoyed apparently robust health; but within the last few years accounts from Germany have reached us of numerous instances of trichinosis. The natives of that country, very specially fond of chopped raw pork, are liable to contract this disease; and in many districts the flesh of pigs is not allowed to be sold without a preliminary microscopic investigation.

'The symptoms usually begin with violent diarrhœa, from the presence of the parasites in the intestinal canal, and if this becomes excessive it may effect a cure by sweeping the intruders out of the system. But if this is not effected, peritonitis may ensue, and when the worms reach the muscular tissue, most violent and excruciating pains set in, with severe cramps and tenderness about the joints; a feverish condition resembling typhoid now supervenes, lasting for four or five weeks, at the expiration of which the patient is frequently carried off by general debility or wasting. The result, however, is not invariably fatal, and those who recover are not liable to suffer any further inconvenience or discomfort.

'In Aiken's Practice of Medicine we meet with some interesting examples of this disease in almost epidemic form, one of the most striking of which happened to the famous German surgeon, Langenbeck, who, while operating on a man's neck in 1863, found the muscles loaded with calcified capsules.

'On inquiry it was found that in 1845 eight persons took part in a church visitation, and seven sat down to a breakfast consisting of ham sausages, cheese, roast veal, and white wine. In three or four days every one was seized with diarrhœa, violent pains, &c.; four died, and the three survivors only recovered after a tedious illness. One of these was the professor's patient; and a suspicion of poisoning having fallen on the innkeeper, he was obliged to give up his business and emigrate. But in October, 1863, a still more terrible event took place which caused widespread consternation throughout the whole of Germany. One hundred and three persons in the prime of life sat down to dinner in a small county town in Prussia, and within a month twenty had died, and eighty were suffering from symptoms of the disease in its most aggravated form. It was proved that the sausage meat consumed during the third course had been prepared from a pig in bad condition, which was not intended for sale but which subsequent examination proved to be swarming with trichinæ.

'The general symptoms of the malady are generally sufficient for its diagnosis, but more exact proof may be obtained by the use of a small harpoon, invented on the continent, which excises and removes a small portion of flesh for microscopic inspection. But, considering that all treatment has hitherto proved ineffectual, it were perhaps better to leave the sufferer in the bliss of ignorance than to torture him with the knowledge of an incurable sickness. Professor Eckhardt, of Giesseu, has however obtained permission to try experiments in this direction on a condemned criminal, and it is to be hoped that this opportunity may be turned to good account.

'Prevention is at all times better than cure, and this we can ensure by the thorough cooking of all the meat we consume. Salting, smoking, or toasting is not sufficient, but rather increases our chances of infection by stimulating the vitality of the worm.

'I sincerely hope that my remarks may not tend to make any of you feel uncomfortable, or cause you to conjure up imaginary dangers in connection with your daily food. It is satisfactory to think that no case of the disease has ever been detected in England, and I cannot do better than wind up with a most reassuring quotation from Cobbold:

"'Looking at the subject in relation to public health, I have no hesitation in saying that a great deal of unnecessary fear has been created in this country. No doubt the imperial authority in Russia had good grounds for recently issuing an order prohibiting the importation of pork into that country, since severe epidemics of trichinosis had occurred in neighbouring German States. In this country, however, ordinary precautions will suffice. English swine are almost, if not entirely, free from this so-called disease; and not a single case of trichinosis in the living human subject has been diagnosed in the United Kingdom. Some twenty or thirty cases have been discovered *post mortem*, and it is highly probable that most, if not all, of these trichinised individuals had contracted the disease during life by eating German pork sausages or other preparations of foreign meat.'"

MEETING HELD DEC. 10:—*Donation:* Skin of Armadillo, by H. M. Larden, (corr. mem.) *Exhibition:*

Collection of Rugby Plants which had obtained the School Prize, by J. D. Armitage.

H. G. Wauton read the following Paper, '*Botanical Notes for* 1870.'

'Early in the spring of this year I noticed to the President that our botanical report for this season was not likely, owing to the entire loss of all our chief botanists, to trouble the Society with its length. The energy of one or two individuals at one time would supply us with a report of some 500 plants noticed with their time of flowering, and 20 or 30 new ones added to our already large list. To keep up the interest in this department of the Society's researches, I proposed that each of the districts into which, for botanical purposes, the neighbourhood has been divided, should each be placed under the special care of a separate member, and that each member should send in at the end of the year the report of his own province; this would ensure a more thorough working out of the country, and make an interesting comparison of dates, localities, &c.

'I undertook myself the district between the Dunchurch and Lawford Roads, of which I have the report before me, and to match which I hope to see other reports from other quarters.

'I have not noticed by any means all I might have done, but I have recorded the time of flowering of over 200 plants.

'Of these 6 are new to the list*

Hyoscyamus niger (L), (black henbane).
Galium tricorne (With).
Orchis pyramidalis (L).
Nymphœa alba (L), (white waterlily).

Anchusa sempervirens (L), } naturalized only.
Fœniculum officinale (All), }

---

* To this list, H. G. Wauton has already (March, 1871) added Veronica triphyllos (L), (found amongst several other Veronicas in a stubble-field), a plant properly only belonging to Suffolk and Yorkshire, and Lithospermum officinale (L), an old-year plant detected by its seeds.

'1 recovered to the list, before considered as lost

Solidago Virga-aurea (L), (golden rod).

'1 important plant to be removed from brackets, as being found now within the required distance of 4 miles

Linaria elatine (Mill).

'Several important plants for which fresh stations have been found, such as

Carduus acaulis (L).
Campanula latifolia (L).
Campanula hybrida (Sm).
Solanum nigrum (L).
Digitalis purpurea (L), (foxglove, once very abundant near Rugby, but now almost unknown).

'I must also record the loss of 2 plants, I fear altogether, to the list, which I looked for but could not find, or rather found gone.

'*Antirrhinum majus* (L), (snapdragon)—only locality an old wall at Lawford Hall; has been on the list as existing on that spot since 1831. Extinct, 1870.

'*Erica tetralix* (L), (heath)—lately found in a few solitary specimens in a lane on the road to Frankton, just past the avenue, now apparently choked to death by furze bushes.

'Lastly, *Campanula patula* (L), one of the best plants on the list. I could only find 2 specimens this year where before I have found a dozen or more. This would be a great loss.

'And now perhaps it would not be uninteresting, at least to those who care about Botany, though I fear they are in a minority, to know a little about the history of these new plants. I have taken the trouble to look them up in the Cybele Britannica.

'*Hyoscyamus niger* is a native roadside plant: as it only grows near villages and on roadsides it is more than probable that it gets carried there with gravel. It is of British type, *i.e.*, whatever its origin, whether foreign or native, it has so assimilated itself to the climate and soil of England, that it is now a universal British plant.

'*Galium tricorne,* so called from the 3 seeds or burs which are reflexed in a curve inward, is closely allied to the common sticky weed in the hedges which everyone knows. It is a plant probably of Germanic type, *i.e.*, belonging to the south-eastern counties which lie by the German Ocean, and which include a large number of local plants. If so, this is quite one of the outside stations for it. In the Cybele Britannica a query is expressed as to its being of Germanic type. In this instance I found it side by side with Silene noctiflora, which is put down as being essentially of Germanic type, and has almost identically the same range. It is probably a colonist introduced with the corn, though such authorities as Hooker and Babington admit it as a native.

'*Nymphæa alba*, the white waterlily, found this summer at Wolston Mill; the natives I heard were very proud of it, and it certainly did look very beautiful growing on the river there. It is difficult to get, for the meadows by the river are strictly kept from trespassers (of which I was one), and the river keeps them jealously in the middle of the stream. The last difficulty I met by taking French leave of a small punt I found, about half full of water, which I hope you may find still there if you go for the same purpose. The plant I find has been known there for the last half-century: I only wonder it has not been found before.

'It is of British type and rather local.

'*Orchis pyramidalis*, of which I found a solitary specimen on the Leamington Railway banks, brings our list of orchises to 5 out of the 10 mentioned in Bentham, a larger proportion than most counties can boast.

'This species is one of those appealed to, to illustrate geological or chemical influence on distribution of plants. Its abundance on chalk, lias, and mountain limestones, in many parts of England, with its entire absence or great rarity in the intermediate tracts, can only be accounted for by the nature of the soil. A so-called chalk or limestone plant restricted to a county or two, may be only a very local one, happening to grow on chalk or limestone: but a species which appears and disappears repeatedly, as we cross a long extent of country, in accordance with the presence or absence of carbonate of lime in the soil, forces one to suppose a connection between the two facts. It is curious there should not be more of it here on this limestone soil: I searched the banks for a mile or more, but could not find a second.

'Lastly, I would call your attention to 2 rare and rather curious monstrosities or varieties of the Herb Paris (to be found in abundance in Coombe wood), which, though its name only allows it to have 4 leaves, (quadrifolia), has taken the liberty in one instance to have 5, in another 6, both, especially the latter, extremely unusual. It is one of those monstrosities which may be put under a distinct head, resulting from luxuriant growth. The 6-leaf species was about 1ft. high.'

W. B. Lowe (member), read a Paper on '*Saxon Remains at Aylesford*,' also exhibiting a series of fossil from the gault collected there this summer.

G. Darbishire (member), read a Paper on '*Flint Weapons found near Thetford*,' comparing them with specimens from Australia, Denmark, New Zealand, and Mexico.

The following Papers were read at the first meeting in 1871, but as their interest is especially connected with 1870, we have decided to print them in this report.

'*Note on the Starlight Evenings of* 1870, *by the Rev. T. N. Hutchinson.*'

'During the past year I have kept a record of the number of evenings in each month that were more or less starlight. My observations do not profess to extend beyond 12 o'clock, so that doubtless the result appears less favourable than it would have done had the early morning hours been included. I ought also to add that the observations have been taken rather from the telescopic point of view, it being well known that those nights on which the stars look most brilliant to the naked eye, are by no means the best suited for astronomical purposes.

‘The results are given in the following table.

‘The first column shews the number of nights in each month that might be called ‘splendid,’ with entire absence of clouds, and first-rate definition for the telescope.

‘The second column gives the evenings that were also continuously starlight, and might be called ‘fine,’ but with less perfect definition, either from excessive sparkling or the reverse, too much haze or vapour.

‘The third column shews the nights which were starlight either for the first or latter part, or at intervals; and the fourth column gives those evenings on which no stars at all appeared, at least before 12 o'clock.

	‘Splendid.’	‘Fine.’	‘Moderate.’	No stars.
January	4	5	9	13
February	0	6	6	16
March	3	5	6	17
April	8	9	5	8
May	5	7	9	10
June	5	10	2	13
July	6	8	3	14
August	From home.			
*September	8	5	4	3
October	3	10	7	11
November	0	2	11	17
December	3	8	4	16

‘The table gives the following results.

‘1. The finest telescope nights were in April and September.

‘2. The only months in which no ‘splendid’ nights occurred were February and November.

‘3. The greatest number of starless nights were in February, March, November, and December.

‘4. In each month more than half the nights were more or less starlight except February, March, November and December.’

---

* From the 10th to the 30th.

Mr. Seabroke (O.R., corr. mem.), who accompanied the Government expedition to Sicily to observe the '*Eclipse of the Sun,*' has supplied us with the following account.

'THE ECLIPSE OF THE SUN, DECEMBER, 1870.

'When the expedition to observe the last total eclipse of the sun was mentioned in the daily papers, and generally talked of, many persons asked why so much public money was spent, and so much time given up by scientific men to see the eclipse. A short account therefore of what a total eclipse teaches us may not prove uninteresting. There was a time—when Halley was astronomer royal—when eclipses of the sun were not much cared for, for we find from Halley's notes a memorandum to the effect that a total eclipse happened on a certain day, but that he did not observe it as he was engaged at the time with friends; but spectroscopes in those days were unheard of, and of solar physics little was known, and it probably appeared obvious that the knowledge of the constitution of the sun would be little increased by attempting to view it when obscured by the moon. But of late years things have changed, and it is found that during an eclipse we have a splendid opportunity offered us of increasing our knowledge of solar physics; and these opportunities, though few and far between, are seized by astronomers and every advantage taken of them; and it has become a recognised thing for the Government to lend its aid to those who volunteer to give up their time to the subject; and this School has not been last in furnishing volunteers, for in 1860, Mr. Wilson, accompanied by, I believe, one or two other Rugbeians, went with the expedition to Spain, and in the expedition last December four Rugbeians* took part. But to return to our subject. In all eclipses as soon as the moon covered the sun, a number of red flames were seen surrounding the dark body of the moon. This is shewn in fig. II. where the circle represents the edge of the sun as ordinarily seen, and the other line the external limit of the red flames as seen by me at the last eclipse. Those flames appeared to extend in some cases for 50,000 miles or more above the edge of the moon, and were found to belong to the sun, but were never seen except when the bright disc of the sun was covered by the moon, on account of our atmosphere between us and the sun reflecting so much sunlight as to completely overpower the weak light of red flames.

---

* Three Corresponding Members of our Society, Messrs. Seabroke, B. E. Hammond, and Fison.—[ED.]

'During the eclipse of 1868 these red flames were examined with the spectroscope, and found to consist of hydrogen in an incandescent state. The day after the eclipse M. Janssen found that with the spectroscope he could see these red flames without the aid of an eclipse, and Mr. Norman Lockyer at the same time independently made the same discovery in this country. By this method the sun, as we ordinarily see it, is found to have an envelope of incandescent hydrogen completely surrounding it to a depth of nearly 4,000 miles, and this layer of gas is subject to immense disturbances, portions of it being thrown up by some power below to heights sometimes exceeding 10,000 miles, so forming the red flames seen in the eclipses. But above the red flames, and surrounding the eclipsed sun, was always seen an halo of light called the "corona," and numerous drawings were made of it by different observers. Fig. I. represents the corona as drawn by Professor Watson during the last eclipse. In some cases it was made to extend to a distance of two or three times the moon's diameter, with a number of coloured rays apparently proceeding from the sun or moon; while in other drawings it only appeared to extend a very short distance—perhaps a tenth of the height figured in other drawings. This corona was carefully examined with the spectroscope during the last eclipse in America, but without very decisive results. It was thought by some to belong to the sun, and by others to be the effect of our own atmosphere; or possibly the moon might be the cause of it. Now the principal object in the last eclipse was to determine what the corona is—of course there were other things to be done, as to determine the time of the contacts of sun and moon as a

Plate VI.

Fig. 1.

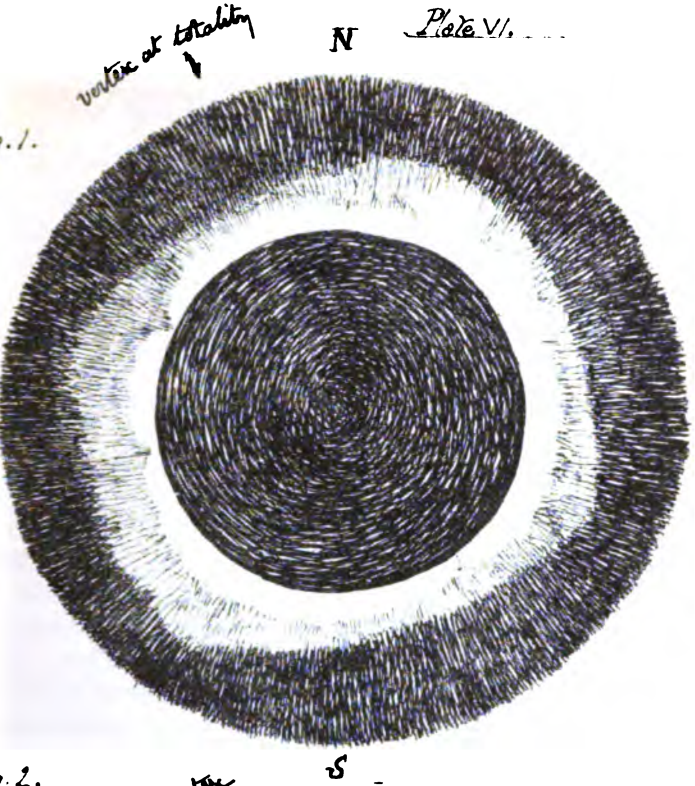
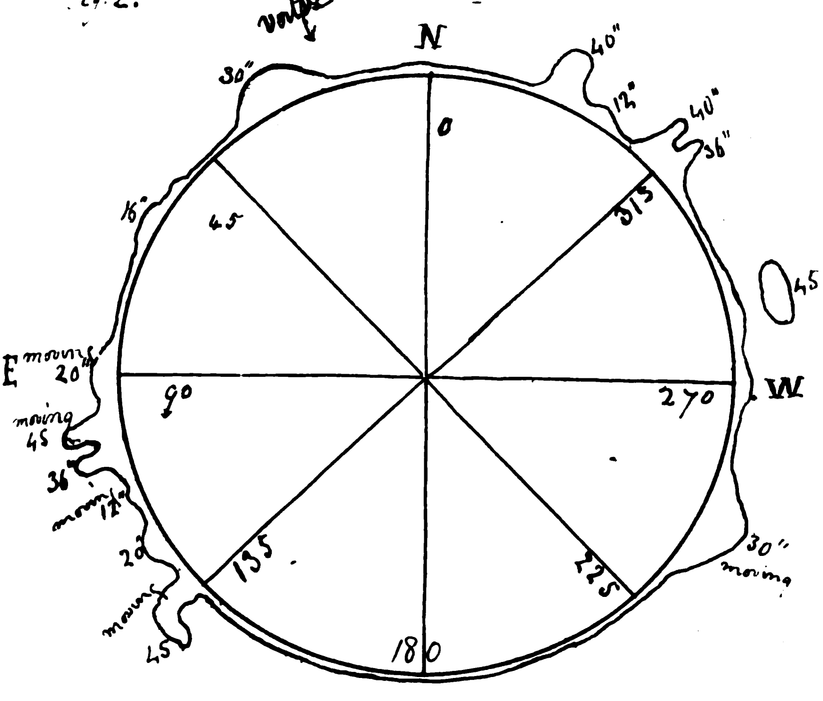


Fig. 2.



check on the solar and lunar tables, the estimation of the chemical intensity of the light for different grades of obscuration, the amount of general darkness, the effect on animals, &c.

'The corona question was to be settled by the assistance of photography, the spectroscope, polariscope, and sketches. I must confine myself to the evidence afforded by the Sicilian expedition, as at present I have only a very general knowledge of what the others have done. The photographs taken by Mr. Brothers show a corona round the sun extending to a distance of about 5′ of arc, and in one photograph rays appeared of a length greater than the diameter of the sun, but very faint. The polariscope showed the light from the corona to be polarised radially. The spectroscope showed a green line on a faint continuous spectrum. The sketch made by Professor Watson (see fig. II. in plate VI.) shows a corona extending for 5′ of arc from sun, with a certain amount of stray atmospheric illumination beyond, but the line of demarcation between this and the corona is very visible. This sketch was compared with a drawing of the chromosphere which I made before totality, and the elevated parts of the corona corresponded in position with the elevations of the chromosphere, showing that the corona belongs to the sun. From this evidence we must conclude that there exists a layer of incandescent gas above the hydrogen of the chromosphere, giving a spectrum consisting of a green line on the faint continuous spectrum always given by incandescent gases, and extending for a distance of 5′ of arc from the limb of the sun as ordinarily seen. This gas is unknown to us and is lighter than hydrogen. It is very probable that the corona extends higher than 5′, but beyond this point it would approach so near to a vacuum that we may take 5′ as its practical limit. Professor Young, by comparing the total amount of light from the corona with that of the chromosphere, and also their respective intrinsic brightness, arrived at the conclusion that its extent is more than 8′; but his process, though theoretically good, is in practice very rough. The radial polarisation is evidence of light reflected from the corona or something in it,—it may be that there are liquid or solid particles in the gas produced by condensation, or meteoric streams may be the cause of it. The light and rays seen in former eclipses extending beyond this envelope, or corona proper, were probably due to our atmosphere, and in some measure to the eyes of the observers, which accounts for the drawing making the corona appear of such various heights. Since the corona gives a monochromatic light, it appears obvious that it can be examined at any time without the aid of an eclipse, in the same manner as the envelope of hydrogen below it can be examined by the Janssen-Lockyer method. Greater dispersive power than is usually used for the hydrogen would of course be required, as the light is so much weaker. We may compare the exterior portions of the sun to the layers of an onion. Corresponding to the outer layer, we have the corona consisting of a gas unknown to us, next comes the hydrogen, then a gas giving a yellow line in the spectroscope intermixed with the hydrogen but not reaching quite to the upper limit of it, and forming with it the chromosphere. Then come the layers of sun as ordinarily seen by us, consisting chiefly of metals in a state of vapour, called the photosphere. The upper layer of the photosphere next below the chromosphere consists of magnesium vapour, then come layers of sodium barium and iron; below these we are uncertain as to the order of layers, although we detect the presence of vapour of a number of substances we have on our earth. More would probably have been done to fix the exact position of the green line of the corona had the weather at Catania been much more favourable, as the largest instruments were there. Mr. Lockyer had a 9in. reflector with one prism, and a vacuum tube giving the spectra of hydrogen and magnesium for comparison. Professor Roscoe had a refractor and iron spectrum for comparison; and I had a 6in. refractor with 6 prisms, and a micrometer in the eyepiece of the spectroscope, so that I could have measured the height of each line in the chromosphere, to see if it really extended higher than it generally appeared without an eclipse. I also had an arrangement whereby the position of any line could be registered by bringing it to the cross-wires of the eyepiece, and pressing a point which made a mark on a strip of paper. Mr. Pedlar also had a small direct vision spectroscope with hydrogen tube for comparison. The chemical intensity of the light taken by Professor Thorpe during totality was *nil*, although there was sufficient light reflected from the surrounding horizon over the sea to render the figures on my micrometer visible. I observed the first contact with the aid of the spectroscope, an idea, I believe, due to Professor Young, and the method seems admirable, the bright hydrogen line being gradually extinguished, so that you have several seconds warning before the instant that the moon appears to touch the photosphere. The only difficulty is in placing the slit on the point of contact; however, having got a near approximation, a sweeping motion should be given to the telescope, and till the position where the bright line is shortest is found, this will be the point of first contact. It is very probable that the observations on the sun's corona will throw some light on the constitution of the terrestrial auroras. The green line of the corona may be found to coincide with one of the principal aurora lines, when the position of each has been more accurately determined, so that we may have a non-luminous corona like the sun rendered sometimes luminous by electric discharges. But our auroras give a red light in some parts, and the spectrum of this is, for aught we know, similar to that of hydrogen, and in other parts it gives a white light and the corona a white one: so we may ask if we have not also a chromosphere and corona, and further, may not the gas constituting the corona be in reality the so-called "luminous ether" more condensed by attraction in the neighbourhood of heavenly bodies? The laws of diffusion of gases would seem to entirely negative all this, but to all appearance they do not hold good with respect to the sun. Again, what can be the constitution of the zodiacal light, and of comets. In all this there is a wide field for speculation, and for mental and manual labour.

'To go further into the subject, and argue *pro* and *con*, would take more time than is at my disposal. I mention these speculations to you, mainly for the purpose of showing that there is a vast expanse for research in astronomy, as there is in all other branches of natural science, and to set, if possible, some of you to work at original researches, each taking up his own pet subject, for we are too prone to think that only the most distinguished men of science are able to make discoveries; but it is by making discoveries that men rise to distinction.'

REPORTS OF SECTIONS FOR 1870.

Geological Section.

Localities new to the list and not recorded in Geological Album:

Fucoids	Rugby Pits
Rhynconella	Rugby Pits and Lower Hillmorton
Terebratula Numismalis	Rugby Pits
Avicula Sinemuriensis	Upper Hillmorton
Lima gigantea	Upper Hillmorton
Pinna	Rugby Pits
Cardinia Listeri	Rugby Pits
Actæonina fragilis	Upper Hillmorton
Tooth of fish	Upper Hillmorton
Remains of Icthyosaurus	Newnham Regis and Long Lawford.
Remains of Plesiosaurus	

During the past year a drain has been dug from the head of Pigstye Lane to the Workhouse, with a branch on the Clifton Road; the depth varied from 12 to 23 feet, but the lias clay was not reached, the whole drain being cut through the brown clay containing striated chalk pebbles.

At the Upper Hillmorton Claypits ammonites of any size are becoming rare; on the contrary, specimens of Montivaltia rugosa, once rare, are now common and of larger size than formerly.

J. ARMITAGE.

Note by C. S. TAYLOR, (corresponding member).

The following extract is taken from page 281 of the Philosophical Transactions of 1791; it is written by Thomas Barker, Esq., of Lyndon, in Rutland, and is appended to some Meteorological observations. It seems deserving of credit from the accurate knowledge which must have been personally obtained of the limits of the chalk formation, and from the circumstantial account of the pit which the author gives; if it is true, it throws considerable light on the mode of formation of the chalky and flinty drift of Rugby.

After correctly describing the course of the chalk in the south of England, from Devonshire one part running along the southern counties to Dover, and another portion leaving the first about Reading, crossing by Dunstable Baldock (in Hertfordshire), and Gog Magog Hills in Cambridgeshire; and after alluding to the chalk in the Yorkshire Wolds, the writer goes on to say, 'I did not know till lately that we had any chalk nearer to us than Maddingley (this is an outlier of the chalk near Cambridge, and is really the nearest chalk belonging to the great mass of the formation); but several years ago the people of Ridlington, in Rutland, digging for stone to mend their roads, met with a bed of chalk, at which they were much surprised and did not know what it was, having never seen a chalk pit before. After I heard of it, I went to examine the place and found it a regular chalk pit, with rows of flints lying in it, as is usual in the south of England. The chalk is not soft like that they write with, but very much like that they dig near Baldock; nor are the flints so black as those in the south of England, but veined, of a light coloured flint, and white, some parts much mixed with chalk, and are broken, not whole ones. They may have dug the pit six yards long and two deep, but how far the chalk reaches I do not know. The ground about it has plainly been formerly dug, perhaps 30 yards square, but completely turfed over again, with the same strong turf as the rest of the close, which is rich pasture land and feeds oxen for the Smithfield market, not like the short grass on the chalky downs. Riding last autumn along the turnpike road near Stukely, in Huntingdonshire, I saw a small patch of chalk, a few yards long, in a bank which had been dug away by the roadside; so that though we did not know there was any chalk at all in this country, and there certainly is very little, yet here are now two places where it has been met with.'

Ridlington is 3 miles N.W. of Uppingham, and about 25 miles N.E. of Rugby; according to the large map of the Geological Society it stands on the lias and lower oolite; it is as nearly as possible the same distance, 44 or 45 miles from the chalk escarpment, as Rugby is.

I have never come across this observation except in an essay of Dr. Buckland's, in the Geological Transactions for 1821; but even if it is known, the original account is interesting.

C. S. TAYLOR.

The following list of fossils in the Oxford Museum, labelled as found near Rugby, has been contributed by C. S. Taylor.

Locality, LAWFORD. This place is once referred to as Lawford Cave, so it is probably the same place as that where the bones were found.

The fossils found at Lawford are:

Brachiopoda—Rhynconella tetraedra; Spirifera rostrata.
Monomyaria—Lima Hermanni.
Dimyaria—Pachyodon; Pholadomya ambigua.
Gasteropoda—Trochus (very like pleurotomaria).
Cephalopoda—Ammonites armatus—Nautilus striatus.

Locality, KILSBY.

Monomyaria—Perna.
Dimyaria—Cucullæa.

There are also other shells labelled Rugby, but I thought that too vague to be of any use to the Rugby collection.

C. S. TAYLOR.

Zoological Section.

Dates of the earliest eggs recorded as taken.

April 2nd. Crow, Rook, Peewit, Moorhen, Magpie, Thrush, Blackbird, Misselthrush.

May 6th. Chaffinch, Greenfinch, Starling, Hedge-Sparrow, Sparrow, Wren, Linnet.

May 11th. Lark.

May 14th. Kestrel.

May 22nd. Yellowhammer.

May 20th. Meadow Pipit.

May 23rd. Sparrow Hawk, Whitethroat, Black-headed Bunting, Greater Tit, Red-backed Shrike.

May 31st. Corn Bunting, Sedgewarbler.

June 2nd. Coot, Lesser Whitethroat, Tree-Sparrow, Golden Crested Wren with young, Blackcap.

N. Masterman.

Photographs presented by T. Higgin, Esq.:—

Arachnoidiscus Ehrenbergii
Pleurosigma formosum
Aulacodiscus margaretaceus
Diatoms from Singapore
Diatoms from Duck Pond, Maine
Diatoms from Bombay
Diatoms from California
Spiracle of Blow Fly
Proboscis of Blow Fly
Sting of Bee
Tongue of Bee
Mite of Humble Bee (Acarus of Bombus terrestris)
Spinnerets of Spider (Epeira Diadema)
Foot of Spider (Epeira Diadema)
Foot of Caterpillar
Tongue of Drone Fly
Tongue of Cricket
Tongue and Lancet of Empis Fly
Head of small Marsh Crane Fly
Yellow Grass Fly (Louchoptera lutea)
Head of Yellow Long-legs (Tipula lutescens)
Proboscis of Anthomyia pluviatilis
Pseudo Scorpion

Botanical Section.

Several new plants have been added to the list: Geum intermedium, found at Coombe by J. Armitage; Cuscuta Hassiaca (Pfeiff), in a field of lucerne belonging to Mr. Edmunds, by Mr. Kitchener; and several plants by H. G. Wauton, for which see page 34.

The Floral dates for the year were contributed by H. G. Wauton, (who has made a careful flora of all the plants in the Dunchurch or 'd' district), J. Armitage, and others.

C. F. Adam.

A list is contributed by H. G. Wauton of plants still out on November, 1, 1870 (weather very mild):—

Carduus palustris
Rubus fruticosus
Carduus lanceolatus
Carduus arvensis
Ulex Europæus
Geranium Robertianum
Campanula rotundifolia
Senecio vulgaris
Chærophyllum temulum
Capsella Bursa-pastoris
Valerianella olitoria
Viola canina
Ranunculus acris
Bellis perennis
Crepis virens
Heracleum sphondylium
Lapsana communis
Sonchus oleraceus
Stellaria graminea
Stellaria media
Lonicera Periclymenum
Vicia sepium
Chrysanthemum segetum
Euphorbia Peplus
Viola tricolor (arvensis)
Brassica sinapistrum
Spergula arvensis
Matricaria camomilla
Hedera helix
Senecio vulgaris

H. G. Wauton.

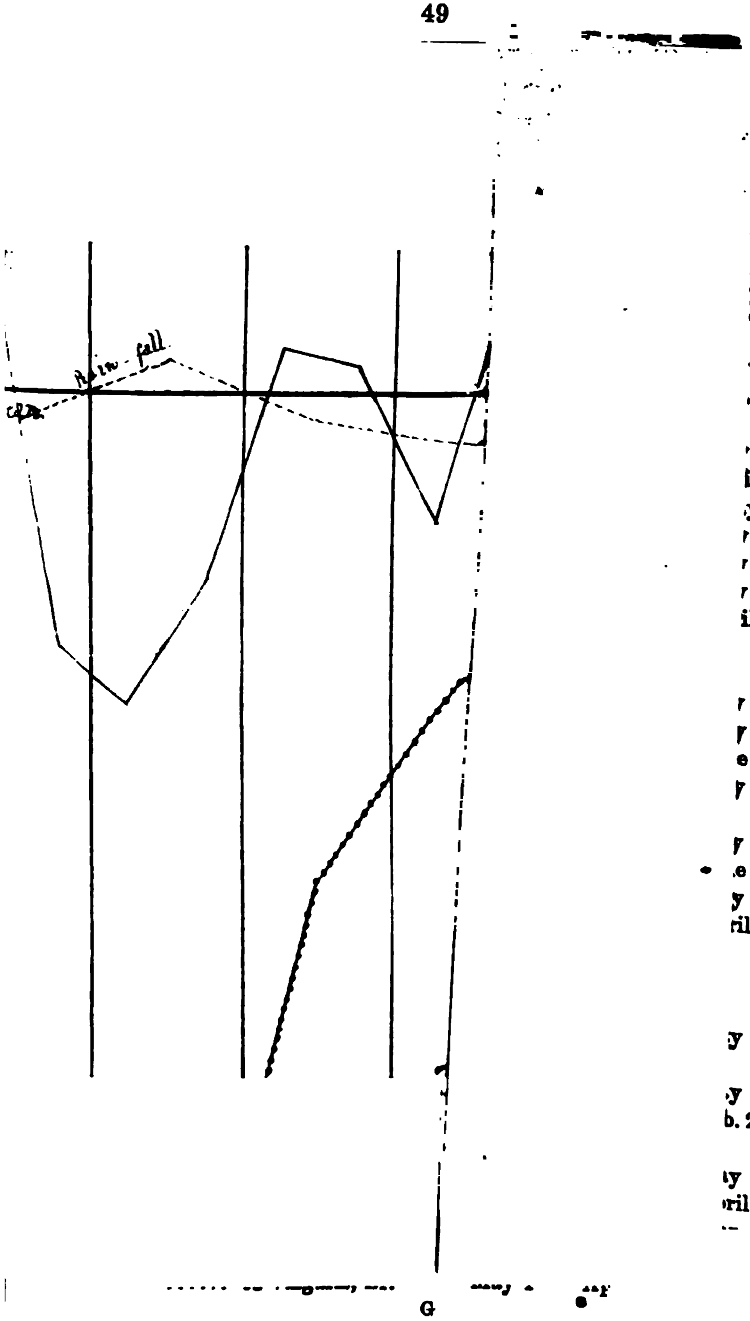
In Plate VII. will be seen a table exhibiting in the manner described on p. 7, the backwardness or forwardness of the year 1870. The line of rainfall was contributed by Captain Constable, of Pailton House. It will be noticed that the early part of the year was uniformly dry, except in February, when much snow fell, and there was extreme cold. Early in March came some very mild weather, which had a marked effect on the vegetation; this advance, however, received a check from the dryness and coldness of the next month.

The following is the table of the year:—

		Average heat at 8.30.a.m.	Total rainfall in inches.	Dates of Flowering.	Excess of heat or deficit.	Excess of rain or deficit per ½ month.
Jan.	1—15	39·5	1·25	10 days late	+ 2¼	— ·30
	16—31	32·			— 5¼	
Feb.	1—15	33·	2·02	21 days late (6 obs.)	— 6·4	+ ·36
	16—28	35·			— 3·9	
March	1—15	37·1	1·15	10 days late (9 obs.)	+ ·9	— ·26
	16—31	36·7			+ ·5	
April	1—15	45·	0·56	6 days late (34 obs.)	— 2·5	— ·47
	16—30	48·			+ 3·4	
May	1—15	48·	0·58	5½ days late (37 obs.)	— 3·4	— ·21
	16—31	55·5	0·09	0 days late (32 obs.)	+ 1·7	— ·70
June	1—15	57·5	0·09	3 days early (50 obs.)	— ·03	— 1·10
	16—30	59·7	0·53	½ day early (39 obs.)	+ 1·7	— ·66
July	1—15	60·1	1·64	5 days early (12 obs.)	+ ·6	+ ·49
	16—31	64·1	0·15		+ 1·9	— 1·00

I may notice the extreme cold of February, the great heat of March 1 and 2, and of the latter half of May, especially May 20, 21, 22, and again of June 17—22.

F. E. Kitchener.



0.
28
l 2
l 15

8
25

6
il 16
y 29
r 6
r 26
r 7
il 15

r 26
y 13
e 8
y 26

y 26
e 3
y 6
ril 25

y 10

y 15
b. 27

y 14
ril 19

No
Ca
Re
Ca
Ca
Ul
Ge
Ca
Se
Ch
Ca
Val
Vio
Ra
Bel
Cre

on
rain
be n
in F
in M
the
and

Jan.

Feb.

Marc

April

May

June

July

F. E. Kitchener.

REGISTER OF PLANTS FOR 1869, AND 1870.

The mean date is the average date from the years 1867—1870; *h* indicates hibernation.

		Mean.	1869.	1870.
Thalictrum	4 flavum, Linn.	June 9	June 12	May 28
Anemone	6 nemorosa, Linn.	Mar. 18	Mar. 15	April 2
Ranunculus	11 a. peltatus, Fries.	April 8	April 8	April 15
	11 circinatus, Sibth.	April 22		
	13 hederaceus, Linn.	April 30	April 22	May 8
	14 Ficaria, Linn.	Feb. 27	Feb. 11	Mar. 25
	15 Flammula, Linn.	June 14	June 12	
	18 auricomus, Linn.	April 22	April 22	May 6
	19 acris, Linn.	April 22	April 25	April 16
	20 repens, Linn.		May 22	by May 29
	21 bulbosus, Linn.	April 27	April 25	May 6
	23 sceleratus, Linn.			May 26
	25 arvensis, Linn.	May 28	May 29	May 7
Caltha	26 palustris, Linn.	April 3	April 3	April 15
Helleborus	30 *fœtidus*, Linn.			
Aquilegia	31 *vulgaris*, Linn.			
Berberis	35 vulgaris, Linn.	May 14	May 7	May 26
Nymphæa	36 alba, Linn.			July 13
Nuphar	37 lutea, Sm.	May 30	May 24	June 8
Papaver	40 Argemone, Linn.	May 20	May 11	May 26
	41 dubium, Linn.	June 4	May 22	
	42 Rhœas, Linn.	May 31	May 12	May 26
Chelidonium	45 majus, Linn.	June 9	June 29	June 3
Corydalis	49 *lutea*, D.C.		April 9	May 6
Fumaria	51 officinalis, Linn.	April 26	April 8	April 25
Coronopus	58 Ruellii, Gaert.		May 28	
Thlaspi	60 arvense, Linn.			
Capsella	63 Bursa-pastoris, DC	always	Jan. 2	
Teesdalia	65 nudicaulis, Br.	April 21	April 10	May 10
Lepidium	67 *latifolium*, Linn.			
	70 campestre, Br.	May 13	May 22	May 15
Draba	79 verna, Linn.	Feb. 18	Feb. 1	Feb. 27
Alyssum	82 *calycinum*, Linn.			
Cardamine	84 amara, Linn.	May 10	May 4	May 14
	85 pratensis, Linn.	April 12	April 19	April 19
	86 hirsuta, Linn.	Mar. 23	by April 8	Mar. 19
Arabis	88 thaliana, Linn.	April 18	April 3	by May 5
Barbarea	95 vulgaris, Br.	May 4	April 25	May 6

		Mean.	1869.	1870.
Nasturtium....	98 officinale, Br.	May 18	May 24	May 25
	99 terrestre, Br.	May 29	May 24	by June 18
	101 amphibium, Br.	May 26	May 24	June 4
Sisymbrium ..	102 officinale, Scop.	May 3	April 21	May 10
Erysimum	106 cheiranthoides, Linn.			by July 4
	107 Alliaria, Linn.	April 20	April 18	April 25
Brassica	114 Campestris, Linn.			May 12
Sinapis	116 arvensis, Linn.		Mar. 25	
Reseda	126 lutea, Linn.	May 23	May 23	
Viola	133 odorata, Linn.	Feb. 28	Feb. 15	Mar. 19
	134 hirta, Linn.	April 8	April 19	April 10
	135 sylvatica, Fries.	April 12	April 11	April 15
	136 arvensis, Murr.	Mar. 29	April 8	April 9
Polygala	141 vulgaris, Linn.	May 20	by June 18	May 10
Silene	152 inflata, Sm.			
	157 noctiflora, Linn.			July 5
Lychnis	162 Flos-cuculi, Linn.	May 15	April 25	May 27
	163 diurna, Sibth.	May 2	April 27	May 6
	164 Vespertina, Sibth.	May 9	May 11	May 7
	165 Githago, Lam.	June 26	June 28	June 25
Sagina	167 apetala, Auct.			May 27
	168 procumbens, Linn.			
	171 nodosa, Meyer			
Spergula	172 arvensis, Linn.		(Jan. 2) *h*	June 4
Spergularia ..	175 rubra, Fenzl		June 5	
Arenaria	178 serpyllifolia, Linn.	June 10	June 26	
	182 trinervis, Linn.	April 21	April 26	May 5
Stellaria	185 media, With.	always	Jan. 4	by Mar. 3
	186 Holostea, Linn.	April 23	April 10	April 19
	188 graminea, Linn.		April 24	May 17
	189 uliginosa, Murr.	May 12	April 24	
Cerastium	191 aquaticum, Linn.		June 29	May 28
	192 glomeratum, Thuill		Feb. 16	
	193 triviale, Link.	Feb. 9	Feb. 1	
Linum	202 catharticum, Linn.	May 21	May 11	May 27
Malva	204 moschata, Linn.		May 30	by July 13
	205 sylvestris, Linn.		May 17	May 29
	206 rotundifolia, Linn.		(Feb. 11) *h*	June 18
Tilia	211 *parvifolia*, Ehrh.			
	212 *intermedia*, D.C.	June 23	July 13	
Hypericum ..	215 perforatum, Linn.	July 6	July 8	June 26
	216 quadrangulum, Auct.	June 24	July 12	June 28
	217 dubium, Leers.		July 18	June 28

F·.DCL·. FE.

		Mean.	1869.	1870.
Hypericum	218 humifusum, Linn.		July 28	
	220 pulchrum, Linn.	June 23	June 1	July 1
	221 hirsutum, Linn.	July 8	July 12	
Acer	225 *campestre*, Linn.			April 23
	226 *Pseudo-platanus*, L.	May 3	April 19	May 20
Erodium	228 cicutarium, Sm.		April 19	by May 27
Geranium	229 *phœum*, Linn.			
	231 pratense, Linn.	June 4	June 12	May 21
	234 pusillum, Linn.			
	235 molle, Linn.	May 6	May 1	May 4
	236 dissectum, Linn.	June 3	June 8	
	238 lucidum, Linn.			May 4
	239 Robertianum, Lin.	May 7	April 29	May 6
	240 *sanguineum*, Linn.			
Oxalis	243 Acetosella, Linn.	April 9	April 11	April 23
Rhamnus	246 catharticus, Linn.	June 3	by June 29	June 4
Sarothamus	248 scoparius, Koch.		April 27	by May 13
Ulex	249 europæus, Linn.	always	Jan. 6	Jan. 31
Ononis	254 spinosa, Linn.	June 15	June 1	June 26
Anthyllis	257 vulneraria, Linn.		May 11	
Medicago	258 *sativa*, Linn.			June 7
	260 lupulina, Linn.	April 30	May 1	May 7
Melilotus	264 officinalis, Willd.		May 29	June 10
Trifolium	267 repens, Linn.	May 31	June 11	May 24
	b *incarnatum*, Linn.			June 2
	271 pratense, Linn.	May 9	May 2	May 20
	272 (medium), Linn.	June 16	June 30	June 3
	273 *hybridum*, Linn.	June 15		June 4
	277 striatum, Linn.			
	280 fragiferum, Linn.			
	281 procumbens, Linn.	June 8	June 11	
	282 minus, Relhau.		June 23	
Lotus	283 corniculatus, Linn.	June 4	June 23	May 20
	284 major, Scop.		June 28	May 23
Ornithopus	291 perpusillus, Linn.	June 28	June 28	
Vicia	297 Cracca, Linn.	June 7	June 26	June 13
	298- *eu-sativa*, Syme, EB	May 12	May 2	May 21
	298-b. (Bobartii), Forst			
	301 sepium, Linn.	May 7	May 11	May 15
	303 hirsuta, Koch.	May 14	May 1	May 29
	304 tetrasperma, Mœn.	June 6	July 8	June 4
Lathyrus	308 pratensis, Linn.	June 6		June 4
Orobus	312 (tuberosus), Linn.	May 25		May 21
Prunus	314- spinosa, Linn.	April 4	April 1	by May 7

		Mean.	1869.	1870.
Prunus	314- insititia, Linn.		April 10	
	316 Cerasus. Auct., var.	April 13	April 19	by May 4
Spiræa	317 Ulmaria, Linn.	June 23	June 28	June 25
	318 Filipendula, Linn.		July 2	
Geum	321 urbanum, Linn.	May 13	(Jan. 8) *h*	May 20
	322 rivale, Linn.	April 29	April 22	May 6
	b. intermedium, Ehr.			May 21
Potentilla	327 anserina, Linn.	May 22	May 24	May 16
	331 reptans, Linn.	June 4	June 20	May 22
	332 Tormentilla, Sch.	May 15	May 24	May 21
	333 Fragariastrum, Eh.	April 8	April 1	April 2
Fragaria	335 vesca, Linn.	April 12	April 20	April 16
Rubus	339 Idæus, Linn.	May 24	May 24	May 21
	340 cæsius, Linn.	June 7	June 12	May 21
	340* fruticosus, Auct., var.	May 25	May 18	June 2
	350 rubiginosa, Linn.			June 18
Rosa	351 canina, Auct.	May 21	May 1	May 30
	353 arvensis, Linn.	June 11	June 29	
Agrimonia	354 Eupatoria, Linn.	June 30	July 8	June 25
	354b odorata, Mill.		July 8	
Sanguisorba	354* officinalis, Linn.			June 18
Poterium	355 Sanguisorba, Linn	May 29	May 11	May 26
	355* *muricatum*, Spach	May 23	May 24	
Alchemilla	356 vulgaris, Linn.	May 13	May 12	May 24
	358 arvensis, Scop.	April 28	May 8	by June 21
Cratægus	360 Oxyacantha, Linn.	April 30	April 25	May 5
Pyrus	363b *mitis*	May 2	April 10	May 18
	366 Aucuparia, Gaertn.		April 25	May 24
Epilobium	367 angustifolium, Lin.	June 24	July 8	June 9
	368 hirsutum, Linn.	July 11	July 20	July 4
	369 parviflorum, Schreb	July 7	July 14	July 4
	370 montanum, Linn.	June 17	June 20	June 9
	372 palustre, Linn.			
	373 tetragonum, "Linn," Benth	June 22	July 7	June 4
Circæa	377 lutetiana, Linn.	June 23	June 12	July 1
Callitriche	383 verna, Linn.	May 18	May 15	by June 1
Ceratophyllum	387 demersum, Linn.			
Lythrum	390 Salicaria, Linn.	July 6	July 12	June 25
Bryonia	393 dioica, Linn.	July 2	July 20	June 28
Montia	394 fontana, Linn.			May 7
Scleranthus	399 annuus, Linn.	June 27	July 13	June 21
Ribes	403 (*nigrum*), Linn.			by May 24

			Mean.	1869.	1870.
Ribes	404	*rubrum*, Linn.	April 15	April 22	April 18
	406	*Grossularia*, Linn.	April 7	April 8	April 15
Sedum	414	acre, Linn.			
	416*	*reflexum*, Linn.			by July 29
Saxifraga	427	granulata, Linn.	May 11	May 1	May 6
	430	tridactylites, Linn.		April 18	
Hedera	438	Helix, Linn.	Oct. 7		Oct. 9
Cornus	439	sanguinea, Linn.	June 12	June 23	June 12
Sanicula	442	europæa, Linn.	May 12	May 15	May 15
Conium	446	maculatum, Linn.	June 21	June 5	July 4
Helosciadium	454	nodiflorum, Koch.	June 27	June 1	July 4
Sison	456	Amomum, Linn.	July 27	July 20	
Ægopodium	457	Podagraria, Linn.			
Carum	458	(*Carui*), Linn.			
Bunium	461	flexuosum, With.	May 17	May 15	May 15
Pimpinella	462	Saxifraga, Linn.	July 27	July 26	July 29
Sium	464	latifolium, Linn.		July 19	
	465	Angustifolium, Linn.			July 15
Œnanthe	470	fistulosa, Linn.	July 13	July 10	July 16
	474	Phellandrium, Lam.			June 18
Æthusa	475	Cynapium, Linn.	June 24	June 28	June 30
Fœniculum	476	vulgare, Gaertn.			July 29
Silaus	479	pratensis	July 10		June 8
Angelica	482	sylvestris, Linn.	June 13		June 14
Pastinaca	486	sativa, Linn.	June 26	June 28	June 25
Heracleum	487	sphondylium, Linn.		March 25	May 13
Daucus	489	Carota, Linn.	July 2	June 23	July 13
Torilis	493	Anthriscus, Gaertn.	June 22		June 25
	494	infesta, Spreng.	June 27		June 30
	495	nodosa, Gaertn.	June 29		July 13
Scandix	496	Pecten-Veneris, Linn.		March 4	by June 3
Anthriscus	497	vulgaris, Pers.			
	498	sylvestris, Hoffm.	April 15	April 10	April 15
Chærophyllum	500	temulum, Linn.		April 24	by May 5
Sambucus	504	nigra, Linn.	May 29	by June 19	June 4
Viburnum	506	Opulus, Linn.	June 14	June 18	May 28
Lonicera	508	Periclymenum, Linn.	June 21	May 22	June 18
Galium	513	verum, Linn.	June 21	June 5	June 13
	514	cruciatum, With.	April 20	April 27	April 27
	515	palustre, Linn.	June 12	June 12	June 3
	517	saxatile, Linn.	June 12	June 12	May 24
	519	Mollugo, Linn.		July 8	
	522	tricorne, With.			by July 5
	523	Aparine, Linn.	May 29	June 16	May 26

			Mean.	1869.	1870.
Sherardia	526	arvensis, Linn.	May 8	May 12	May 21
Asperula	527	odorata, Linn.	April 30	April 25	May 6
Valeriana	531	dioica, Linn.	May 19	June 28	May 16
	532	officinalis, Linn.	June 23	July 8	June 4
Valerianella	534	olitoria, Moench	May 8	April 28	by June 4
	537	dentata, Koch.		July 1	
Dipsacus	539	sylvestris, Linn.			
Scabiosa	541	succisa, Linn.		July 11	
Knautia	543	arvensis, Coult		June 29	
Tragopogon	544	pratensis, Linn.	June 6	June 12	May 28
	549	hispidus, Linn.			
Hypochœris	553	radicata, Linn.	June 6	June 23	May 21
Lactuca	557	(muralis), " D.C."	June 6	July 8	
Sonchus	559	arvensis, Linn.		June 17	
	560	asper, Hoffm.	May 27	May 24	June 12
	561	oleraceus, Linn.	June 2	May 24	May 30
Crepis	563	virens, Linn.	May 17	May 1	May 21
Hieracium	568	Pilosella, Linn.	May 17	June 23	May 28
	573	sylvaticum, Sm.			
	584	umbellatum, Linn.			July 30
Taraxacum	588	officinale, Wigg.	Jan. 27	Jan. 20	Feb. 6
Lapsana	590	communis, Linn.	June 18	June 9	June 25
Cichorium	591	Intybus, Linn.			
Arctium	592	Lappa et Bardana			June 30
Serratula	594	tinctoria, Linn.			July 16
Carduus	595	nutans, Linn.	June 9		June 25
	596	crispus, Linn.	June 9	June 1	June 14
	599	lanceolatus, Linn.	June 15	June 1	July 7
	600	eriophorus, Linn.			
	601	palustris, Linn.	June 8	May 24	June 13
	602	arvensis, Curt.		June 12	June 13
	606	acaulis, Linn.		July 14	Aug. 10
Centaurea	611	nigra, Linn.	June 16	June 19	June 14
	612	Cyanus, Linn.	July 3	July 2	June 28
	613	Scabiosa, Linn.			
Artemisia	626	vulgaris, Linn.			July 16
Gnaphalium	632	uliginosum, Linn.	July 30	June 28	July 1
Filago	635	germanica, Linn.	July 4	June 19	July 7
Petasites	636	vulgaris, Desf.	Mar. 20	Mar. 1	April 16
Tussilago	637	Farfara, Linn.	Feb. 21	Feb. 16	Mar. 3
Solidago	642	Virgaurea, Linn.			July 30
Senecio	643	vulgaris, Linn.	always	Jan. 1	Jan. 31
	644	sylvaticus, Linn.		July 8	July 29
	647	erucæfolius, Linn.			

			Mean.	1869.	1870.
Senecio	648	Jacobæa, Linn.	July 2	June 30	June 11
	649	aquaticus, Huds.	July 9	June 10	July 7
Inula	658	dysenterica, Linn.			July 26
Bellis	660	perennis, Linn.	Feb. 9	Jan. 9	Mar. 19
Chrysanthemum	661	segetum, Linn.	June 8	May 28	June 19
	662	Leucanthemum, Linn.	May 19	May 2	May 21
	663	*Parthenium*, Pers.			
	663*	Tanacetum, Syme.			July 7
	664	inodorum, Linn.	May 24	(Mar. 23 *h.*)	May 24
	665	Chamomilla, E.Mey		June 29	May 26
Anthemis	669	Cotula, Linn.	June 24		June 18
Achillea	670	Ptarmica, Linn.		July 14	
	671	Millefolium, Linn.	June 6	May 24	June 14
Campanula	675	rotundifolia, Linn.	June 30	July 19	June 25
	676	patula, Linn.			
	678	latifolia, Linn.			July 7
	684	hybrida, Linn.		June 28	May 26
Jasione	687	montana, Linn.			
Erica	690	Tetralix, Linn.			
Calluna	695	vulgaris, Salisb.			
Ilex	713	Aquifolium, Linn.	May 9	May 1	May 19
Ligustrum	714	vulgare, Linn.	June 22	June 26	June 18
Fraxinus	715	excelsior, Linn.	April 22	May 1 (fruit)	April
Vinca	716	*minor*, Linn.	April 10	Mar. 23	May 7
Erythræa	724	Centaurium, Per.		July 8	
Menyanthes	727	trifoliata, Linn.			
Convolvulus	729	Arvensis, Linn.	June 9	June 25	June 29
	730	Sepium, Linn.	June 16	June 19	June 25
Hyoscyamus	736	niger, Linn.			June 4
Solanum	737	nigrum, Linn.			Aug. 3
	738	Dulcamara, Linn.	June 4	June 19	June 2
Datura	—	*Stramonium*, Linn.			
Lycium	—	*barbarum*, Linn.		April 29	
Verbascum	740	(Thapsus), Linn.			
Veronica	747	arvensis, Linn.	always	Feb. 7	
	750	serpyllifolia, Linn.	May 4	April 28	May 10
	754	Anagallis, Linn.	June 11	June 26	June 14
	755	Beccabunga, Linn.	May 22	June 5	May 20
	756	officinalis, Linn.	May 28	May 24	by July 7
	757	(*montana*), Linn.		April 27	by May 21
	758	Chamædrys, Linn.	April 27	April 18	May 7
	759	hederæfolia, Linn.	always	Jan. 1	Mar. 29
	760	agrestis, Linn.	always	Jan. 20	April 6
	761	polita, Fries.	Mar. 26	Mar. 21	

		Mean.	1869.	1870.
Veronica	762 *Buxbaumii*, Ten.		Feb. 21	May 14
Bartsia	765 Odontites, Huds.	July 10	July 12	July 2
Rhinanthus	767 Crista-galli, Linn.	May 31	June 5	May 19
Melampyrum	770 (pratense), Linn.	June 8		June 18
Pedicularis	773 sylvatica, Linn.			May 21
Scrophularia	774 nodosa, Linn.	June 6	May 24	June 18
	775 aquatica, "Linn."	June 3	May 24	June 14
Digitalis	778 purpurea, Linn.	June 10	June 19	June 14
Linaria	781 Cymbalaria, Linn.			June 18
	782 spuria, Mill.			
	783 elatine, Mill.			July 30
	785 vulgaris, Mill.	June 20		June 7
Lycopus	801 europæus, Linn.			July 30
Mentha	806 aquatica, Linn.			
	807 sativa, Linn.			July 5
	808 arvensis, Linn.			
Thymus	810 Serpyllum, Linn.	June 20	June 29	June 26
Calamintha	815 Clinopodium, Spen.	July 14	July 12	
Teucrium	818 Scorodonia, Linn.			July 5
Ajuga	822 reptans, Linn.	May 6	April 22	May 13
Ballota	825 nigra, Linn.	June 25	byJuly12	June 4
Lamium	827 Galeobdolon, Crantz	May 17		May 6
	828 album, Linn.	always	Jan. 20	Jan. 31
	829 (*maculatum*), Linn.			
	830 amplexicaule, Linn.		Mar. 5	April 6
	831 purpureum, Linn.	always	Jan. 12	Feb. 6
	831* incisum, Willd.		April 25	
Galeopsis	832 Ladanum, Linn.			
	834 Tetrahit, Linn.	June 29	June 28	
Stachys	836 Betonica, Benth.	June 26	June 12	June 18
	837 palustris, Linn.		July 12	
	838 sylvatica, Linn.	June 8	June 11	June 12
Nepeta	841 Glechoma, Benth.	April 1	April 10	Mar. 29
	842 Cataria, Linn.			
Marrubium	843 vulgare, Linn.			by Aug. 9
Prunella	844 vulgaris, Linn.	June 20	June 23	June 12
Scutellaria	845 galericulata, Linn.	June 17	June 23	June 14
Myosotis	847 palustris, With.	June 1		June 12
	852 arvensis, Hoffm.	April 22	April 26	April 15
	853 collina, Hoffm.	April 24	April 8	May 10
	854 versicolor, Lehm.	May 20	April 28	May 10
Lithospermum	856 arvense, Linn.		byJune28	May 15
Symphytum	859 officinale, Linn.	June 19	June 29	June 4
Lycopsis	862 arvensis, Linn.		June 28	May 27

		Mean.	1869.	1870.
Anchusa	864 *sempervirens*, Linn.			June 18
Echium	869 (vulgare), Linn.			
Primula	878 vulgaris, Huds.	Mar. 2	Feb. 22	Mar. 13
	880 veris, Linn.	April 20	April 19	April 15
Lysimachia	888 nummularia, Linn.		July 14	June 13
	889 (nemorum), Linn.	June 9	July 8	May 24
Anagallis	890 arvensis, Linn.	June 23	June 26	July 5
Plantago	901 major, Linn.	June 18	June 14	June 30
	902 media, Linn.	May 8	April 25	May 6
	903 lanceolata, Linn.	April 28	April 25	May 10
Chenopodium	911 rubrum, Linn.			
	914 album, Linn.	June 12	June 12	June 18
	917 Bonus-Henricus, Linn.		June 28	June 20
Atriplex	923 patula, Linn.	June 9	June 12	
	923a angustifolia, Sm.			
Polygonum	933 amphibium, Linn.			
	933b terrestre			
	935 Persicaria, Linn.	June 27	June 28	June 21
	937 Hydropiper, Linn.		June 12	
	939 aviculare, Linn.	June 29	June 25	July 1
	941 Convolvulus, Linn.	June 14	June 12	June 5
Rumex	944 crispus, Linn.			
	947 obtusifolius, Auct.			June 21
	948*conglomeratus, Mur.			
	951 Acetosa, Linn.	May 8	May 1	May 21
	952 Acetosella, Linn.	May 11	May 1	May 10
Daphne	955 Laureola, Linn.			Mar. 30
Euphorbia	962 Helioscopia, Linn.		April 19	
	968 Cyparissias, Linn.			June 1
	971 exigua, Linn.	June 11	June 23	May 4
	972 Peplus, Linn.			April 7
	973 (*Lathyris*), Linn.			
Buxus	975 sempervirens, Linn.	Mar. 1	Feb. 20	
Mercurialis	976 perennis, Linn.	Mar. 18	Mar. 6	
Urtica	978 urens, Linn.		by April 10	
	979 dioica, Linn.	May 23	by June 29	May 23
Parietaria	982 officinalis, Linn.		June 29	
Humulus	983 Lupulus, Linn.			July 29
Ulmus	984 montana, Sm.			
	985a campestris, Sm.	Mar. 8		Mar. 21
Quercus	988 pedunculata, Ehrh.	May 8	May 13	May 6
Fagus	989 sylvatica, Linn.			
Carpinus	990 Betulus, Linn.			
Corylus	991 Avellana, Linn.	Feb. 21	Feb. 13	Mar. 14

			Mean.	1869.	1870.
Alnus	992	glutinosa, Linn.	Mar. 20	Mar. 18	Mar. 30
Betula	993	alba, Linn.			
Populus	995	alba, Linn.			
	997	tremula, Linn.		Mar. 18	
	998	*nigra*, Linn.	Mar. 30	April 11	Mar. 19
Salix	1002	alba, Linn.			by May 9
	1007	viminalis, Linn.			Mar. 30
	1011	aurita, Linn.			by May 10
	1012	caprea, Linn.	Mar. 5		Mar. 30
Pinus	1029	*sylvestris*, Linn.			May 14
Taxus	1031	*baccata*, Linn.		Feb. 5	
Neottia	1036	Nidus-avis, Rich.		by Mar. 7	
Listera	1038	ovata, Br.	May 11	by June 22	May 21
Epipactis	1039	latifolia, 'Br.' Benth.			July 13
Orchis	1045	Morio, Linn.	May 5	April 27	May 10
	1046	mascula, Linn.	May 1	April 29	
	1051	pyramidalis, Linn.			by July 5
	1052	latifolia, Auct.		April 29	byJuly 28
	1053	maculata, Linn.			June 3
Habenaria	1055	bifolia, 'Br.' Benth.			May 2
Ophrys	1060	apifera, Huds.		June 19	June 18
Iris	1067	Pseudacorus, Linn.		June 24	June 4
Galanthus	1073	*nivalis*, Linn.		Feb. 16	
Leucojum	1075	*æstivum*, Linn.			
Lilium	1076	*Martagon*, Linn.			
Hyacinthus	1093	nonscriptus, Linn.	April 19	April 22	May 6
Ruscus	1097	*aculeatus*, Linn.		Mar. 23	
Paris	1103	(quadrifolia), Linn.		April 22	byMay6
Tamus	1104	communis, Linn.	May 25	May13(bud)	May 24
Elodea	1107*	*canadensis*, Linn.		June 19	
Alisma	1109	Plantago, Linn.	June 28	June 23	July 1
Sagittaria	1113	sagittifolia, Linn.	June 20	July 20	July 13
Butomus	1114	umbellatus, Linn.	June 17	July 12	June 8
Potamogeton	1119	pectinatus, Auct.		June 24	
	1121	pusillus, Linn.			
	1124	crispus, Linn.			
	1125	perfoliatus, Linn.	June 14	June 24	June 7
	1126	lucens, Linn.			June 8
	1132	natans, 'Linn.' Ben.	June 8	June 26	June 3
Lemna	1138	minor, Linn.		June 19	
	1139	gibba, Linn.			
Arum	1142	maculatum, Linn.	April 30	April 27	May 28
Sparganium	1145	simplex, Huds.			July 30
	1146	ramosum, Huds.	June 23	June 25	June 18

			Mean.	1869.	1870.
Typha	1148	angustifolia, Linn.			
Juncus	1151	conglomeratus,L.	June 19	June 19	June 14
	1152	glaucus, Sibth.			
	1157	lamprocarpus,Ehrh.		June 22	
	1162	bufonius, Linn.			
	1169	sylvatica, Bich.			
Luzula	1170	pilosa, Willd.		April 23	May 21
	1172	campestris,Willd.	April 10	April 19	April 16
Scirpus	1184	lacustris, Linn.	June 10	June 26	June 4
	1191	sylvaticus, Linn.	June 9	June 24	June 4
	1192	palustris, Linn.		June 19	May 29
Eriophorum	1201	polystachyon, Linn.			
Carex	1211	ovalis, Good.		June 8	
	1222	vulpina, Linn.	May 21	May 15	May 27
	1228	vulgaris, Fries.		May 27	
	1232	acuta, Linn.			
	1247	sylvatica, Huds.	May 21	May 15	
	1249	Pseudo-cyperus, Linn.			
	1250	glauca, Scop.			May 21
	1251	præcox, Jacq.	May 6	May 6	May 8
	1257	hirta, Linn.		by July 12	
	1260	paludosa, Good.			May 7
	1261	riparia, Curt.	May 3		May 27
Phalaris	1269	arundinacea, Linn.			June 14
Anthoxanthum	1271	odoratum, Linn.	May 9	May 4	May 7
Phleum	1273	pratense, Linn.		April 10	May 28
Alopecurus	1278	pratensis, Linn.	May 25	June 12	May 10
	1279	geniculatus, Linn.			
Arundo	1294	Phragmites, Linn.		June 26	
Aira	1300	cæspitosa, Linn.			
	1310	pubescens, Linn.			
Avena	1311	flavescens			
Arrhenatherum	1312	avenaceum, Beauv.			June 25
Holcus	1313	lanatus, Linn.			
Triodia	1315	decumbens, Beauv.			
Molinia	1319	cærulea, Moench.			
Catabrosa	1320	aquatica, Presl.			
Glyceria	1321	aquatica, Sm.			May 21
	1322	fluitans, Br.	June 7	June 25	May 29
Poa	1328	annua, Linn.		Feb. 16	Feb. 6
	1332	trivialis, Linn.		June 3	
Briza	1335	media, Linn.	June 3		
Cynosurus	1337	cristatus, Linn.	June 4	June 12	May 28
Dactylis	1339	glomerata, Linn.		Mar. 22	May 28

		Mean.	1869.	1870.
Bromus	1349 asper, Linn.			June 10
	1350 sterilis, Linn.	May 24		May 28
	1356 mollis, Linn.			
Lolium	1363 perenne, Linn.	May 28	April 27	May 21
Hordeum	1367 pratense, Huds.			May 28
	1368 murinum, Linn.			May 28
Polypodium ..	1374 vulgare, Linn.			
Polystichum ..	1383 ('aculeatum'), Roth.			
	1384 angulare, Newm.			
Lastrea	1387 Filix-mas, Presl.			
	1391 dilatata, Presl.			
Athyrium	1394 Filix-fœmina, Roth.			
Scolopendrium	1402 vulgare, Lym.		Jan. 20	June 3
Blechnum	1403 boreale, Sw.			Mar. 30
Pteris	1404 aquilina, Linn.		April 1	
Equisetum	1422 arvense, Linn.	April 21		April 16
	1424 palustre, Linn.			May 10
	1425 limosum, Linn.			June 8

NOTE. In the above list the names of plants growing slightly more than 4 miles from Rugby are put in brackets. The word *always* is intended to mean that in an average year the plant is found out as soon as our observers return to Rugby after the Christmas holidays. We cannot always command an observer at Rugby in the holidays.

Entomological Section.

The Society's Cabinet contains 30 drawers, corked and glazed, which are now in process of being ruled and named, so as to be able to contain specimens of all British Lepidoptera, as they are presented. Space is left for 4 of ordinary species, 3 or 2 or 1, if rare, and 5 or 6 or even more, if very variable. The work takes a long time, although there is little to shew for it when done; the process of measuring, pasting, cutting, ruling, &c. being tedious, and requiring great care. It is hoped however that the Cabinet may be completed and placed in the Society's room in the course of the Summer Term.

The nomenclature followed is Stainton's; but the Curator intends to keep an interleaved copy of Doubleday's Synonymic List (the most recent one) in the Society's room, and enter there the details of capture of all the more important of the Society's specimens. To each specimen in the Cabinet will be attached a letter or initials, indicating the name of the donor.

The Cabinet has been arranged down to the Geometrae, Genus Acidalia; so that Butterflies, Hawks, Bombyces, and Noctuae, are already in their places; and small contributions (of sound specimens) will be thankfully received.

Subjoined are lists (1) of the benefactors, and donors of specimens, (2) of those insects of which the Society's series is complete, as far as the Noctuae. The specific names only are given.

(1)
Mr. C. W. Hayward
Mr. A. H. Wratislaw
Mr. J. M. Wilson
Mr. F. E. Kitchener
Mr. A. Sidgwick
Mr. W. C. Marshall
Mr. G. B. Longstaff
Mr. F. W. Haslam
Mr. A. F. Buxton

(2)
Machaon
Cratægi
Brassicæ
Rapæ
Napi
Cardamines
Rhamni
Edusa
Pruni
Quercus
Dispar
Phlæas
Argiolus
Alsus
Ægon
Alexis
Adonis
Corydon
Arion
Sibylla
Paphia
Aglaia
Adippe
Euphrosyne
Artemis
Cardui
Atalanta
Io
Urticæ
Polychloros
Galathea
Cassiope
Blandina
Semele
Janira
Tithonus
Megæra
Ægeria
Hyperanthus
Davus
Pamphilus
Linea
Sylvanus
Tages
Tipuliforme
Stellatarum
Atropos
Tiliæ
Ocellatus
Populi
Minos
Loniceræ
Statices
Rubricollis
Complanula
Dominula
Caja
Quercus
Festiva
Baja
Instabilis
Stabilis
Cruda
Oxyacanthæ
Occulta
Tincta

A. SIDGWICK.

The following notices are extracted from the Entomological Album, kept by D. A. OGILVIE :—

Some caterpillars bred from eggs of S. Tiliae. These when born are remarkable for the enormous size of the horn, which is light-coloured at first, but turns black after being exposed 40 minutes to the air. This moth is very easily obtained in the chrysalis state, as the elms in the neighbourhood swarm with them. They prefer dry soft soil, mossy turf, or even leaves; always avoiding the light. They change in from 7 to 10 days. [When the larva is about to turn and is descending its tree, it entirely loses its green colour, and becomes dirty-greyish.—A. S.]

In May 5 or 6 Betularia (Pepper) were bred. The females though shut up in the box, attracted males: though there were only two imprisoned in the box, 4 or 5 males were seen climbing up, and endeavouring to force an entrance. Two bats which were hawking about took advantage of their exposed condition and devoured them.

Trochilium Tipuliforme, common at Rugby. The larvae live in currant stems, and lie dormant during the winter, reviving when the sap begins to ascend. This seems to be the case with all the wood-consuming Lepidoptera.

In 1868 the Island swarmed with Zeuzera Aesculi, but they have been very rare since. Now the larva takes 3 years to grow, and hence the period of plenty comes round this year (1871); collectors are therefore recommended to scrutinize the Island trees in the Summer Term, as there ought to be a goodly crop.

[Hibernia Progemmaria, Cheimabolia Brumata, and Anisopteryx Aesculi have already appeared this season (1871). The latter is at present to be found in great plenty on the Rugby lamps at night, at least on the Bilton Road (20th March). This season will probably prove a late one, owing to the unusual frost, which may perhaps have also killed a good many insects.—A. S.]

RUGBY:
W. BILLINGTON, PRINTER,
MARKET PLACE.

RUGBY SCHOOL
NATURAL HISTORY SOCIETY.

1871.

a

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

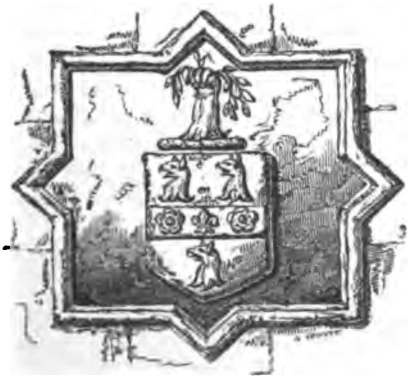
REPORT

OF

THE RUGBY SCHOOL
NATURAL HISTORY SOCIETY

FOR THE YEAR

1871.



"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1872.

PREFACE.

OUR fifth Report will tell our friends what we have been doing; we appeal to it not without some confidence: but as heretofore we confess that in many points we are only beginning.

Meteorological and Astronomical work was begun in 1871, and has been heartily carried out by those members of the School who were competent to serve.[*]

The Geological and Botanical Sections have carried on their work as in former years, and a large Entomological Section is springing up: but the Zoological Section, strange to say, still seems to do the least work.

With the new year however some life seems to have come into it, and we hope in this respect to report more favourably next year.

As an aid to this Section, Mr. G. H. Morrell has made a magnificent present of Dissections similar to those in the Oxford Museum, and Mr. C. S. Taylor has performed the laborious task of writing a description of each Dissection as far as possible in un-technical language, in order to make the Dissections intelligible to the unlearned. These Dissections are now to be seen in our Room in a case presented by the Headmaster.

From the many to whom the Society is indebted in the past year, we may single out the Rev. A. Bloxam for a collection of plants; the Marlborough Natural History Society for a collection of fossils; and those gentlemen who entertained the Society on our expedition, under Mr. Wilson's guidance, to Charnwood Forest.

We venture to call the attention of our critics to the fact that nearly all the papers printed are written by actual Members of the School.

The popularity of our Society seems undoubted: for our numbers have *doubled* during the year, and our last meeting was the largest we have ever had. But perhaps the best sign of all, is the fact that this spring each Section has begun to hold its own fortnightly meetings, from which all but real workers are to be excluded, and where the work to be done may be apportioned out to each Member of the Section.

---

[*] Mr. Wilson wishes us to state here that he will be happy to see all members of the School at the observatory any fine night, and Mr. Hutchinson also invites those interested in the subject to come and make use of his 6¼in. reflector.

What we want of our Associates is, that each of them should choose his line and stick to it. We do not want any ornamental Associates. We want those who love the dictum that 'nine-tenths of the good work done in this world is drudgery.' We have lots of drudgery for you, and besides the other tenth which is not. Come and join the Society, and after proving your mettle as an Associate, earn your election as a full Member.

F. E. KITCHENER, President.
J. ARMITAGE, } Secretaries.
H. RICARDO, }

SOCIETY'S ROOM,
MARCH, 1872.

NATURAL HISTORY SOCIETY'S ACCOUNTS FOR 1871.

Receipts.

		£.	s.	D.
By balance from last year		3	15	1
Hon. Members, Mr. Moberly, Mr. Dukes		1	0	0
Compositions		16	10	0
Subscriptions, Lent Term, (including arrears)	3 7 6	9	5	0
Ditto, Trinity Term	3 2 6			
Ditto, Advent Term	2 15 0			
Sundries		0	3	0
		£30	13	1

Expenses.

	£.	s.	D.
Furniture, and Linoleum for Museum	5	3	6
Keys to ditto	3	5	10
Binding Books, Portfolios, &c.	0	17	2
Anastatic Press	3	3	0
New Reports supplied	2	16	0
Paper for Herbarium	1	18	0
Prizes for Essays	1	11	6
	£18	15	0
Balance in President's hand	11	18	1
	£30	13	1

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any Office is vacant, the Committee do recommend a Member or Associate, or (for the Office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That there never be more than 20 Members.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any name be submitted to the Committee for Membership or Association, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

LIST OF THE SOCIETY, LENT TERM, 1872.

Officers :

President: Mr. F. E. Kitchener, F.L.S.
Secretary: H. R. Ricardo
Curator: (Lent Term), F. R. Hodgson
Editors: The President, the Secretary, and J. Armitage
Album Keepers: Botanical, H. G. Wauton
,, ,, Geological, W. B. Lowe
,, ,, Entomological, A. F. Buxton
,, ,, Zoological, J. G. Adamson
Entomological Curator: Mr. A. Sidgwick

Honorary Members :

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. J. E. Smith
Rev. C. Elsee
Mr. Ker
Rev. C. E. Moberly
Mr. C. Dukes, B. Sc.

Corresponding Members :

Lord Bishop of Exeter
G. F. Helm, M.D.
E. P. Knubley, 68
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H.M. Geological Survey, 67
C. L. Rothera, 68
F. W. Fison, 67
C. S. Taylor, 67
E. Cleminshaw
G. B. Longstaff, 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
F. R. Smith
E. W. Prevost
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S., 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H.M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
D. A. Ogilvie

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year. We have this year omitted from this list the names of those who left the School before the passing of Rule xiii, and have never since leaving made any communication to the Society. Any of those, who wish to have their names replaced on the list should communicate with the President.

Members:

H. G. Wauton
J. Armitage
F. R. Hodgson
G. Darbishire
W. B. Lowe
H. R. Ricardo
C. G. Steel
E. T. Wise
W. R. Wise
A. G. Burchardt
F. A. B. Miller
A. F. Buxton
J. G. Adamson

Associates:

J. E. Higgin
W. H. Cornish
L. Jeffery
T. H. Lewis
J. Meeson
H. W. Scholfield
A. B. Pearson
W. H. Cross
C. M. Chadwick
W. S. Higgin
W. S. Jackson
S. Bolton
F. Swanzy
J. E. Paul
E. J. Taylor
G. L. King
E. B. Sargant
J. W. Johnson
W. H. Sparrow
J. Y. Bostock
H. B. Hemming
W. H. Prichard
T. B. Eden
H. J. Falk
C. A. Ludlam
W. R. King
F. D. Atkinson
H. J. Solly
H. M. Philby
H. N. Hutchinson
J. R. Hutchinson
T. F. Johnson
H. O. Arnold
A. D. Cassavetti
A. A. T. Attree
F. W. Dutton
L. Parry
H. Vicars
W. C. Berkley
J. O. Beuttler
J. D. Harris
O. Henderson
F. A. Frost
C. E. West
W. W. Clarke
G. J. Foster
G. G. Millais
H. B. Browne
W. Phillips
C. P. Eden
C. H. Sargant
J. N. Stolterfoht
L. Knowles
A. Duff
F. G. Howell
J. Hume
S. Crosse

LIST OF PAPERS.

PAGE

On Rugby and its Neighbourhood, by C. T. Clough* - - 15

On Boulders recently discovered near Rugby, by Mr. Wilson - 19

On Oolitic Drift at Brownsover, by Mr. Wilson - - - 20

On Jupiter, by A. M. Worthington* - - - - 24

On Cold Week in May, by E. Burchardt* - - - 25

On the Hook in the Wings of Male Sphinges, by D. A. Ogilvie* 31

On a Supposed Correlation of Eye and Ear, by H. Ricardo* - 34

On the Observation and Use of Pets, by F. R. Hodgson* - 37

On Sun-spots, by Rev. T. N. Hutchinson - - - 45

On Dates of Flowering, by Mr. Kitchener - - - 46

Astronomical Report, by Mr. Wilson - - - - 1

Meteorological Report, by Rev. T. N. Hutchinson - - 41

Botanical Report, by H. G. Wauton* - - - - 47

Geological Report, by W. B. Lowe* - - - - 52

Zoological Report, by J. G. Adamson* - - - - 53

Entomological Report, by Mr. Sidgwick and A. F. Buxton* - 54

Catalogue of Local Fossils in Museum - - - - 55

LIST OF PLATES.

PLATE I. Map of Rugby, by H. Ricardo* - - - 15

PLATE II. Jupiter, by A. M. Worthington* - - - 24

PLATE III. Hawk Moths, by D. A. Ogilvie* - - 32

PLATE IV. Sun-spots, by Rev. T. N. Hutchinson - - 45

PLATE V. Diagram of Rain, Heat, and Floral Dates in 1871 - 46

---

* Those marked with a star are, or were at that time, actual members of the School.

REPORT ON THE TEMPLE OBSERVATORY, MARCH—NOV., 1871, BY MR. J. M. WILSON,

Read December 2nd.

As no account has been laid before the Society of the origin of this Observatory, I shall begin my report by a brief historical notice.

Several years ago, in 1866, the Bishop of Exeter had expressed to me a strong wish that the School should possess a first-rate telescope, and there was some attempt to raise a sufficient sum to buy one. But the Tercentenary was close at hand, with its very heavy calls on the Masters, and so the scheme had to wait. But in the winter of 1870 an opportunity occurred for the purchase of a very fine instrument, and it will be given to the School as a Temple Memorial as soon as some preliminary matters can be settled.

The telescope was made by Alvan Clark and Sons, of Boston, U.S., for the Rev. W. R. Dawes, one of the most accomplished and industrious observers of this century. It is equatoreally mounted, and driven by clock work of peculiar and very successful mechanism, of which I fear no description would be intelligible. The aperture is 8¼ inches, and the focal length 110 inches.

It was brought to Rugby on March 10th, 1871. On the 13th the meridian was approximately determined by magnetic observations, and the foundation of the pier to support the instrument was laid: and, on the night of the 16th, the meridian obtained was corrected by observations of the pole star. The days from the 23rd to the 30th were spent in erecting the observatory and instrument. Some days were then spent in adjusting the position of the instrument, and the indices; putting the driving clock in order: and on April 8th the final instrumental errors were very carefully determined, and have been twice subsequently verified.

The objects of this Observatory are two: to give an opportunity to any and all in the School to see the most marvellous and the most sublime of the works of God, and to understand more than can be got from books alone of Practical Astronomy; and also to provide the means whereby any one of sufficient industry and ability may contribute towards the advance of the Science.

For the Educational object of the Observatory very much is still wanted. An orrery, devised by Mr. Seabroke and myself, is in slow process of construction; but we need celestial photographs, optical models, books, and diagrams. But there is one essential for the use of the Observatory; an essential, moreover, which every one has it in his power to provide, and without which all other educational appliances are useless; and that is that you should personally come, and come often, to the Observatory. We keep a journal in which most of the visitors' names are recorded, and I see that during the last six months rather more than 200 names have been entered. I can give nothing but a general invitation, because in this uncertain climate the weather is very likely to disappoint a pre-arranged visit: you must come on a fine evening, and take your chance of finding us able to admit you. There is probably no fine evening in the Term in which the Observatory is not open from 8 o'clock till midnight, and though Mr. Seabroke and I have been often interrupted, we are both of us willing to be interrupted still more.

As regards the original work to be done in an Observatory I must explain that, for want of an astronomical clock and a transit instrument, a certain class of work is altogether out of our reach. This is conducted at the great Observatories of the kingdom, at Greenwich and Cambridge, &c. And even if we had those instruments, no amateur work on this class of subject could for a moment compare in value with the long continued, systematic observations made at these Observatories. We can do effectually all that pertains to relative and not absolute position; as in the mapping of *star groups*, and the position of *binaries* and *double stars:* we can contribute something that may be of real value in observing the markings on the *planets* with the view of determining, if possible, their physical state; and there is the whole field of *celestial spectroscopy* still open.

Very little has yet been done in mapping complicated *star groups;* yet there are few more promising subjects for investigation. It is millions to one against a group like the Pleiades, or the cluster in Perseus, being physically unconnected with one another. They form a system; and must have relative motions, though they may be extremely slow. These will only be detected by the comparison of observations made at the intervals of many years. Yet no one is taking them now: it is a matter for the deepest regret that the opportunities for these present measurements, which can never recur, are being lost to the world.

The simplest case of a star group is a *binary star.* There are many stars in the heavens which seem to the naked eye single, but with even a small telescope are seen to consist of two stars very near one another. It was not till the year 1767 that it occurred to any one that the stars in such a case would most probably be affected by mutual gravitation, and in fact be describing orbits round their common centre of gravity. This suggestion was made by Michell, Professor of Geology at Cambridge; but it was reserved to Sir William Herschel to prove that the suggestion was well founded, by publishing in 1804 observations of his own on the positions and distances of many binary stars, which had changed during the twenty years during which he had observed them. His observations, and those of his great son, Sir John Herschel, have at the present time a singular value from their early date. Sir John observed and measured altogether no less than 3347 double stars. The great Russian astronomer, Otto Struve, also engaged in the same research, and in 1837 published the positions of 3112 double stars. Mr. Dawes, the former owner of our telescope, was a remarkably fine observer of these objects, and I believe his observations include nearly 4000 double and multiple stars. But this is a work which by its very nature needs going over again, and to this accordingly we are devoting considerable attention. The measures consist of estimates of the angle that the line joining the stars makes with the meridian, and of the angular distance of the stars. And it is possible from a sufficient number of such observations to eliminate errors and to determine the orbits and periods of these stars.*

I give in an appendix the results of our measurements during the past six months. In making them A. M. Worthington, at that time a member of the School, now of Trinity College, Oxford, gave considerable assistance; and some other members of the School have occasionally contributed. I do not attach great weight to any of the measures, as we have not yet had sufficient practice. But I am unwilling to suppress any bonâ fide observations made without bias; and if they are bad, the computation of the orbits will shew that they are so. In all 39 stars have been measured, the number of measures being 434.

It is very desirable to make many good observations on the markings on *planets*. There can be no doubt that this will lead to some further knowledge of their physical state. We have therefore made numerous drawings of Mars, Venus, and Jupiter, and of these I exhibit enlarged copies to the Society. The markings on Mars are satisfactorily shewn to consist of polar snows, land and water, the outlines frequently masked by clouds, so frequently as to have rendered it up to the present time impossible to construct a satisfactory map of Mars. We have made 20 drawings of Mars. Venus is a difficult object in a telescope. It is best observed in daylight shortly after sunrise. We have been able to make a considerable number (27) of drawings, principally due to Mr. Seabroke, some of which have been copied in the pages of the *English Mechanic* for October 20th, 1871. This is a kind of observation which members of the School, after some qualification of themselves in the use of the instrument, might well undertake. The essential mental quality for it is truthfulness, not to fancy you see what you do not see. Jupiter is singularly interesting. Apart from the interest attached to this mimic solar system from watching the revolutions of his satellites, their eclipses, transits, &c., there is the perpetual study of his varying belts. I exhibit a few kindly sent me by Mr. Gledhill, of Halifax. What the physical condition of Jupiter is remains somewhat doubtful. Its rapid rotation, less than 10 hours, and its very small density, less than ¼ of that of the earth, indicate probably that it is not wholly a solid body, and that its cloud belts are made by its own heat and not that of the sun. Much light may be thrown on this by observing its cloud belts, and seeing whether they are or are not influenced by the position of the sun. This again needs nothing but a truthful eye and mind and a good telescope. We have five drawings of Jupiter. We have watched two of the four *comets* which have been lately visible, and especially Encke's: of which we have got several drawings. Mr. Seabroke also examined it spectroscopically, and shewed that its light consists of three lines, as shown in the accompanying diagram. The comet was at the time of observation on a star, and the star's continuous spectrum was

---

* This was illustrated and explained by diagrams.

LIST OF THE SOCIETY, LENT TERM, 1872.

Officers:

President: Mr. F. E. Kitchener, F.L.S.
Secretary: H. R. Ricardo
Curator: (Lent Term), F. R. Hodgson
Editors: The President, the Secretary, and J. Armitage
Album Keepers: Botanical, H. G. Wauton
" " Geological, W. B. Lowe
" " Entomological, A. F. Buxton
" " Zoological, J. G. Adamson
Entomological Curator: Mr. A. Sidgwick

Honorary Members:

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. J. E. Smith
Rev. C. Elsee
Mr. Ker
Rev. C. E. Moberly
Mr. C. Dukes, B. Sc.

Corresponding Members:

Lord Bishop of Exeter
G. F. Helm, M.D.
E. P. Knubley, 68
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H.M. Geological Survey, 67
C. L. Rothera, 68
F. W. Fison, 67
C. S. Taylor, 67
E. Cleminshaw
G. B. Longstaff, 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
F. R. Smith
E. W. Prevost
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S., 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H.M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
D. A. Ogilvie

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year. We have this year omitted from this list the names of those who left the School before the passing of Rule xiii, and have never since leaving made any communication to the Society. Any of these, who wish to have their names replaced on the list should communicate with the President.

Members :

H. G. Wauton
J. Armitage
F. R. Hodgson
G. Darbishire
W. B. Lowe
H. R. Ricardo
C. G. Steel
E. T. Wise
W. R. Wise
A. G. Burchardt
F. A. B. Miller
A. F. Buxton
J. G. Adamson

Associates :

J. E. Higgin
W. H. Cornish
L. Jeffery
T. H. Lewis
J. Meeson
H. W. Scholfield
A. B. Pearson
W. H. Cross
C. M. Chadwick
W. S. Higgin
W. S. Jackson
S. Bolton
F. Swanzy
J. E. Paul
E. J. Taylor
G. L. King
E. B. Sargant
J. W. Johnson
W. H. Sparrow
J. Y. Bostock
H. B. Hemming
W. H. Prichard
T. B. Eden
H. J. Falk
C. A. Ludlam
W. R. King
F. D. Atkinson
H. J. Solly
H. M. Philby
H. N. Hutchinson
J. R. Hutchinson
T. F. Johnson
H. O. Arnold
A. D. Cassavetti
A. A. T. Attree
F. W. Dutton
L. Parry
H. Vicars
W. C. Berkley
J. O. Beuttler
J. D. Harris
O. Henderson
F. A. Frost
C. E. West
W. W. Clarke
G. J. Foster
G. G. Millais
H. B. Browne
W. Phillips
C. P. Eden
C. H. Sargant
J. N. Stolterfoht
L. Knowles
A. Duff
F. G. Howell
J. Hume
S. Crosse

‘room, and a fine beam of sunlight is reflected down a tube ‘from a heliostat on the roof, for comparison with the light ‘from the vacuum tube.

‘The usual method of comparing the spectra of two kinds ‘of light is to allow one half of the slit to be illuminated by ‘one light, and the other half by the other, so that on looking through the spectroscope the two spectra are seen in ‘contact, one above the other, so that the coincidence of ‘lines is at once seen. This method, however, does not ‘answer in comparing the faint hydrogen spectrum with the ‘solar spectrum except for the three principal lines; since ‘the brightness of the solar spectrum obliterates the weak ‘hydrogen lines. I was obliged therefore to adopt the ‘following method. A fine platinum wire was placed in ‘the eye-piece of the spectroscope, and the line under examination brought into coincidence with it. Sunlight was ‘then thrown in, and the position on the solar spectrum ‘with respect to the black lines noted. By this means the ‘position on Fraunhofer's scale is at once found. Each line ‘was thus compared from 10 to 20 times in order to eliminate error.

‘The pressure of the hydrogen used in these experiments ‘varied from 3 to 4 mm. of mercury. Above and below this ‘pressure the fainter lines disappear. In Appendix No. 2 ‘is a list of the lines already compared. I hope to finish ‘the rest next summer.

‘Professor Young has published a list of 103 lines seen ‘by him in the chromosphere, and on examining his list I ‘find only the four brightest hydrogen lines coincide with ‘any in his list, viz., the C, F, near G, and H lines; a fact ‘which has been known a long time. The remaining lines ‘therefore in my list have probably not yet been seen in the ‘spectrum of the hydrogen in the chromosphere. The ‘excessive faintness of some of the hydrogen lines may be ‘judged of by the fact that the eye required to be kept 'in perfect darkness for 5 or 10 minutes before it could distinguish them.

'A large number of experiments were made to ascertain 'the best conditions under which to examine the hydrogen 'so as to get the lines at their maximum brightness. When 'an electric spark is passed through the gas the principal 'lines appear under nearly every condition: but the 'faint ones do not appear so readily. 1stly, experiments 'had to be tried in order to ascertain the best pressure: '2ndly, a number of tubes were tried with different sized 'necks between the bulbs: 3rdly, the battery power had to 'be ascertained: 4thly, the best size of the Leyden jar 'which is interposed to heat the spark had to be ascertained. 'The results of these experiments showed that the following 'were good conditions; viz., a pressure of from 3 to 4 mm. 'of mercury, the neck of the tube $\frac{1}{16}$th inch internal diameter; a battery of 12 Smees; and as large a coil as possible 'without any Leyden jar.'

After the meeting Mr. Wilson and Mr. Seabroke showed a number of spectroscopes, and among them that which was spoken of in the paper as used with the telescope in mapping the prominences on the sun. It was fitted with a reflecting prism, and adjusted for comparison of the spectra of a candle and a spirit flame in which salt was burning. It divides the D line widely.

APPENDIX 1.

DOUBLE STARS. MAY—NOVEMBER, 1871.

Name of Star.	Position observed in degrees.	No. of obs.	Distance observed	No. of obs.	Date.	Observer.
22 Andromedæ			4″.46	6	1871.84	W & S
	71.8		4″.91	4	1871.81	S
251. Piscium	312.97	8	20″.46	2	1871.85	W
	311.65	4	19″.96	8	1871.90	S
γ Leonis	113	4	3″.78	3	1871.44	W, S, AMW
ξ Ursæ Maj.	43.9	4	2″.2	1	1871.44	W, S, AMW
γ Virginis	159.2	6	5″.49	3	1871.49	W, S, AMW
	160.1	6	5″.40	4	1871.47	W, S, AMW
	156	1	4″.72	4	1871.47	W, S & JA
ζ Bootis	298.9	3			1871.49	W
ε. Bootis	327.2	4	2″.97	4	1871.60	S
44.Bootis	229.8	4	5″.3	4	1871.64	S
η Coronæ Bor.	45.2	5	1″.47	3	1871.60	S
	50	4	1″.38	4	1871.63	S
μ_2 Bootis	AB.171.9	1			— —	
	BC.167.95	4	elongated		1871.64	S
δ Serpentis	192.1	5	3″.56	4	1871.61	S
σ Cor. Bor.	AB.194.3	3	3″.51	2	1871.50	
	AC.88.2	1	53″.5	2	— —	W
μ. Draconis	177.5	4	2″.44	4	1871.64	S
α Herculis	115.07	6	5″.63	4	1871.51	W & S
	113.8	3	5″.03	4	1871.48	AMW & W
δ Herculis	181.27	6	10″.15	3	1871.47	W,S,AMW,DAO
ρ Herculis	311.9	3	4″.54	2	1871.50	W
	311.3	4	4″.34	4	1871.51	W & S
μ Herculis	244.83	3	31″.7	3	1871.51	W, S, AMW
Anonyma	276.9	4	1″.32	3	1871.57	
95 Herculis	261.46	5	6″.65	5	1871.52	W
	261.7	3	6″.47	4	1871.54	W & CPR
70 Ophiuchi	92.8	3	4″.6	3	1871.47	W, S, AMW
	92.5	4	4″.67	2	1871.48	W & AMW
73 Ophiuchi	252.8	6	1″.48	3	1871.49	W, S, CJES
Anon. in Clyp.Sob found by AMW	AB.6.7	5	3″.8	2	1871.60	S
	AC.29.5	2	14″.77	1	— —	
59 Serpentis	316.25	11	4″.6	5	1871.55	W, S, RHK
Anon. [Σ. 2319]	AB.193.2	5	5″.6	3	1871.60	
	AC.273.85	2	41″.8	1	— —	W & S
α Lyræ	151.5	1	57″.7	2	1871.60	S
	152.1	3	57″.58	2	1871.58	S
ε. Lyræ	AB.14.3	4	3″.18	4	1871.63	
	AC.173	4	210″.8	4	— —	S
	CD.146.3	4	2″.48	4	— —	

Name of Star.	Position observed in degrees.	No. of obs.	Distance observed	No. of obs.	Date.	Observer.
149 Cygni	63.38	8	6″.17	4	1871.87	W & S
	62.5	4	7″.32	4	1871.88	S
ϖ. Aquilæ	118.25	4	1″.7	4	1871.61	S
α Aquilæ	313.96	5	158″.9	5	1871.61	S
ψ Cygni	183.7	4	3″.3	7	1871.66	S
178 Delphini	AB.255.32	5	15″.5	3	1871.57	
	Bb215-220	2			— —	W & S
61 Cygni	113.12	5	19″.47	4	1871.61	S
μ Cygni	AB.123.7	4	4″.12	4	1871.78	W
	AC.62	2			— —	
κ. Pegasi	301.7	4	11″.78	4	1871.63	S
ξ Cephei	284.1	4	6″.5	4	1871.76	W & S
33 Pegasi	AC.331.7	4	63″.7	5	1871.64	S
ζ Aquarii	337	7	3″.79	8	1871.65	S
	335.2	4	3″.81	4	1871.78	W
* in Pegasus	144.2	4	13″.54	4	1871.67	S
Anon. 2457 Dawes	19.1	8			1871.77	W & AMW

Explanation of names of Observers—

W .. Mr. Wilson.
S .. Mr. Seabroke.
CJES .. Rev. C. J. E. Smith.
RHK .. Mr. Ker.
AMW .. A. M. Worthington.
JA .. J. Armitage.
DAO .. D. A. Ogilvie.
CPR .. C. P. Ridley.

APPENDIX 2.

Reference No.	Position on Kirchoff's Scale	Relative Brightness. 10 Brightest	Remarks.
1	694	10	C.
2	881		Limit of a number of close lines towards C.
3	930	5	Brightest red line.
4	1014	5	Suspiciously near the chromosphere line near D.
5	1049	3	The position of these was taken by reference to the mercury lines, and are therefore not so reliable as the others.
6	1061	4	
7	1119	3	
8	1533	4	
9	1621	4	
10	1876	4	
11	1943	3	
12	1991	6	
13	2065	3	
14	2080	10	F.
15	2235	4	Near here; exact place uncertain.
16	2361	6	
17	2428.5		Limit of a band towards F.
18	2540	2	
19	2605	3	
20	2670	3	
21	2767		Faint band.

On comparing the above table with the Catalogue of Chromospheric Lines, by Professor Young, in the *Philosophical Magazine* for November, 1871, I see no sufficient signs of coincidence to lead me to believe that any of the chromospheric lines in his list are due to hydrogen, except the C and F already well known to be so due. Since I have not yet examined lines further than 2767, the near G (2796), and H lines also known to be due to hydrogen, are not mentioned in the above list. In these experiments, a spectroscope with a large dispersive and magnifying power was found to be required in order to identify the lines in the solar spectrum, so that the hydrogen spectrum became so reduced in brightness that, in order to see the fainter lines, the eye required to be kept for some minutes in the dark room, although with a spectroscope of low power the spectrum appeared very bright and full of lines.

MINUTES OF MEETINGS.

MEETING HELD FEB. 11, 1871:—*Donations:* Report of the Marlborough and Folkstone Natural History Societies; Leaves of Pitcher Plant (Nepenthes Rafflesiana) and Sarracenia purpurea, by Mr. Micholls; Specimens of Lavatera arborea, and Muscari racemosum, by Mr. W. C. Marshall.

A Paper was read by Mr. G. M. Seabroke, (corr. member), '*On the Eclipse of the Sun, December,* 1870,' as witnessed by him in Sicily.*

The Rev. T. N. Hutchinson, (hon. mem.), then read a report '*On the Starlight Evenings of* 1870.'*

E. A. Burchardt, (member), exhibited experiments on the Rose of Jericho (Anastatica hierochuntica).

MEETING HELD FEB. 25:—After various exhibitions, a Paper was read by H. Ricardo, (member), on '*Mediæval Architecture,*' tracing the origin of the Norman, Early English, Decorated, and Perpendicular styles, and giving the special characteristics and notable examples of each. The Paper was beautifully illustrated by drawings and diagrams by H. Ricardo. The Rev. T. N. Hutchinson also exhibited a series of diagrams, illustrating the Paper.

---

* These two Papers, as referring immediately to 1870, were printed at the end of the Report for that year. See pp. 37, 39.

Mr. Hutchinson exhibited a drawing of the large Sunspot lately observed by him, and indicated the reasoning by which its size could be determined.

Mr. Wilson announced that he had received a set of Meteorological instruments from Mr. Scott, (O. R.), the head of the Meteorological department, and that it had been arranged that Rugby should send reports of its observations to the Government office.

Arrangements were made for a series of observations, the firstfruits of which will be seen in the Meteorological Report.

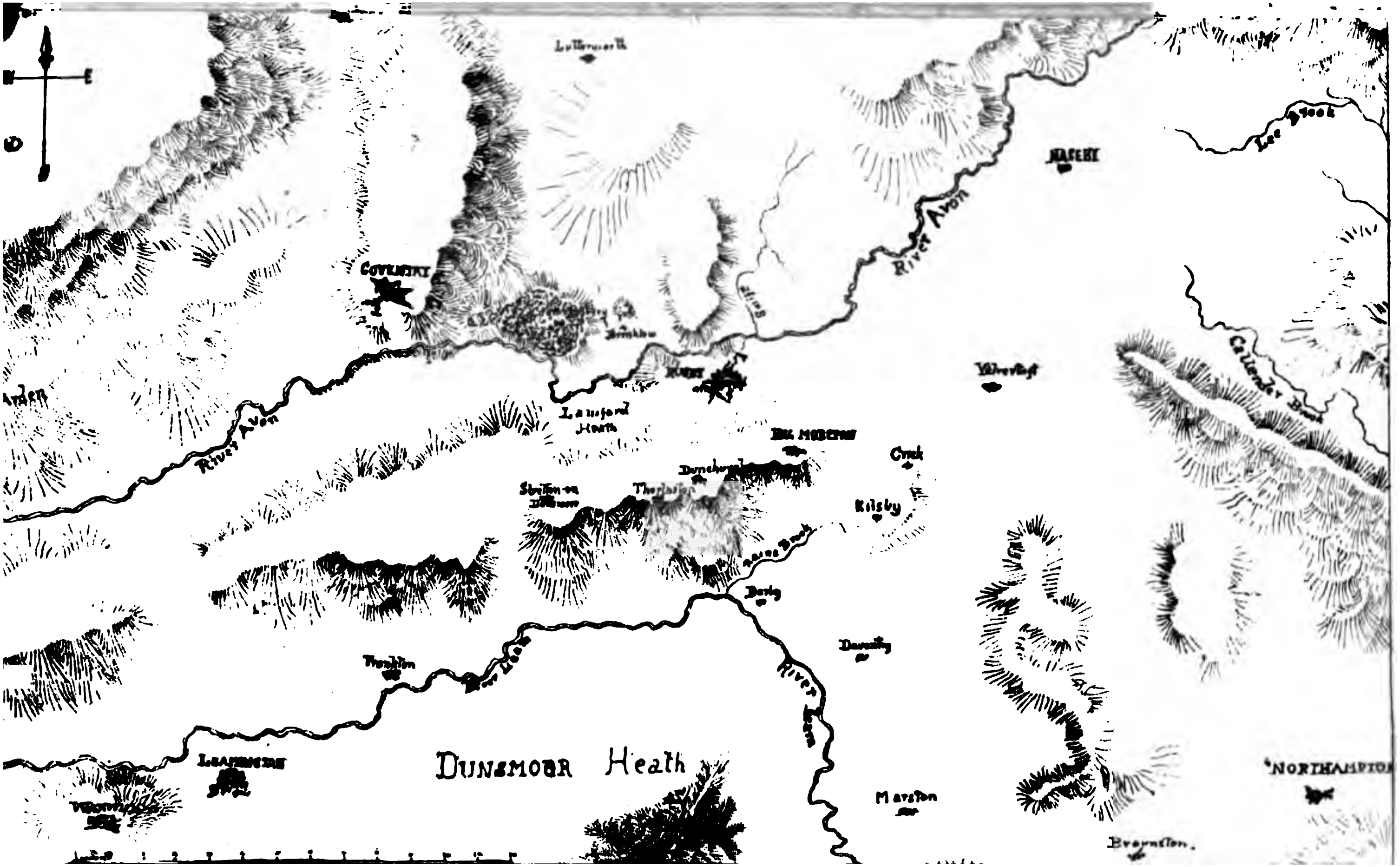
Mr. Sidgwick called attention to some facts as to the nature of Monkeys given in Mr. Darwin's new book on 'the Descent of Man.'

MEETING HELD MARCH 11:—*Donations:* Case for Botanical Specimens, by the President; Eggs from Lapland, by Professor Newton; Indian snakes, by Mr. Ker.

The President exhibited and explained a diagram illustrating the dates of flowering in 1870.

A Paper was read by C. G. Steel, (member), on '*Meteorology,*' noting the usefulness of the science as shewn by predictions founded on a careful series of observations, explaining the system carried out at the stations in connection with the Meteorological office, and showing how the laws of winds and cyclones had been determined by observation. It was illustrated by the weather reports of the Meteorological Office.

MEETING HELD MARCH 25:—*Exhibitions:* First specimen of Gonepteryx Rhamni taken this year, by F. R. Hodgson; Fossils from Toft, by W. B. Lowe;


Lutterworth
Lee Brook
NASEBY
River Avon
Swift
COVENTRY
Brinklow
RUGBY
Yelvertoft
Callender Brook
Arden
River Avon
Lawford Heath
HILLMORTON
Crick
Dunchurch
Stretton on Dunsmore
Thurlaston
Kilsby
Rains Brook
Barby
Daventry
Frankton
River Leam
River Leam
LEAMINGTON
DUNSMOOR Heath
Marston
NORTHAMPTON
Braunston.

Photographs of the late Solar Eclipse, taken at Syracuse and Cadiz, by Mr. Hutchinson.

Dr. Farquharson, (hon. member), read a Paper on '*Animal Heat.*'

The following Paper (see Plate I.) was then read by C. T. Clough, (member), on '*Rugby and its Neighbourhood.*'

'In writing this short paper on the neighbourhood of Rugby, I shall merely endeavour to sketch roughly the chief natural features within a radius of about 15 miles, without going into the causes through which they have been formed.

'The town of Rugby itself is situated on a small plateau which belongs to the short range of hills which passes through Hillmorton, Thurlaston, and Stretton-on-Dunsmore, where we may consider the range ceases. The whole range can be seen very well on the road from Kilsby to Hillmorton, just before you cross over the canal bridge. To the south of this range there is another much longer and more decided one; this includes Barby Hill, the hill through which the Kilsby Tunnel passes, and further on to the east the hills near Naseby, which are generally considered the centre of England. Towards the west the range sweeps down southward to Daventry, where is Borough Hill, the culminating point of the range, at the top of which there are some large encampments, supposed to be of Danish origin. This hill is upwards of 800ft. and consequently on a clear day a very fine view can be obtained from the top; Coventry and Weedon are visible, and nearer still two lakes, one of which has a perimeter of nearly 3 miles, where there is very good fishing. The range does not cease at Daventry, but divides itself there, one part going on to Weedon and the other continuing on to Marston, where it gives a twist to the east and keeps on to within about 6 miles of Northampton. Both these ridges are moderately continuous, and hence we might have expected to find several tunnels here and there; and in reality besides the Kilsby Tunnel there are two tunnels for canals each about one mile in length—one near Crick, and the other near Braunston. At

Blisworth, near Northampton, there is also a canal tunnel about one mile and a half in length. The lias and chalk formations meet about one mile from Daventry, so that the chief range is composed of the same material as the Yorkshire Wolds, which however attain a much greater elevation. About two miles from Daventry, on the road from Kilsby to Daventry, I saw a pit of lias similar to the one near the Roman Catholic Chapel at Rugby. There are several offshoots of this range, which is not itself visible, being hidden by the spur of Barby Hill, which can be seen from the road from Hillmorton to Dunchurch, such as Napton-on-the-Hill.

'To the north of Rugby, in the direction of Lutterworth and Combe Abbey, the ground is chiefly occupied with gentle undulations, though there is rather a steep bit of ground about two miles from Combe Abbey, near Brinklow. But still further on, in the N.W. part of Leicestershire, between Ashby-de-la-Zouch, Mt. Sorrel, and Leicester, there is the district which still retains its ancient name of Charnwood Forest, though most of the trees have long since disappeared. This district is occupied by a ridge of hills of inconsiderable elevation, but rugged and with sharp, distinct outlines. Bardon Hill, between Ashby and Leicester, the highest of the group, is about 860ft. above the level of the sea. It is considered by some people to command a wider prospect than can be found anywhere else in the island. From it on a clear day you can see, northwards, Lincoln Cathedral and the various heights of the High Peak in the north of Derbyshire. Southwards, you can see the Malvern Hills, the Shropshire Wrekin, and the Dunstable Hills which are 80 miles off. Several mountains in N. and S. Wales can also be seen. Indeed it has been said that right lines drawn from the extremities of the view would include nearly a quarter of England and Wales. From the character of this district we might have presumed at once that the geological formation was much harder than the Rugby lias. Isolated beds of mountain limestone, which thus connects this district with the still wilder one of North Derbyshire, and the Yorkshire Moors, the offshoots of the Cheviots, and other primitive rocks, such as greenstone and slate, crop up here and there. Some of the rocks are quarried under the name of granite, part of which I believe finds its way to Rugby and helps to mend the roads. The erratic blocks of granite which are found now and then near Rugby are generally supposed to have come from this district. Coarse slate is also found, which serves for roofing and other common purposes. A little further on to the west is the somewhat similar district of Ashby Woulds.

'To the north-west of Rugby, just before you reach Coventry, there is a small ridge of about four miles in length, and still further on in the same direction there is another rather longer ridge, called Heave's Green Ridge. Further on still is the wooded district of Warwickshire, called Arden. This name is similar to that of the woods called Ardennes in N. of France; hence perhaps this word is a common Celtic one for a forest. In the time of its splendour this forest was the largest British one in existence; it extended from the Avon to the Trent on the north, and to the Severn on the west. The Forest of Dean, on the borders of the adjacent counties of Monmouth and Gloucester, was perhaps part of this ancient forest. In Shakespeare's play of "As you Like it," the forest of Arden, in France, is introduced;—may not the idea of this play have been put into his head by this ancient Warwickshire forest, which in his time would no doubt reach very near to Stratford-on-Avon? Although no longer a continuous forest, it is still the best wooded part of the county, affording plenty of timber, especially oaks. Not very far from Banbury (about 6 miles), and almost directly 18 miles south of Rugby, is the ridge of Edge Hill, which serves as the boundary line between Warwickshire and Oxfordshire. This has a very steep declivity and commands an extensive prospect. It overlooks the valley of the Stour, and the Vale of the Red Horse, so called from the figure of a horse in its ferruginous sands. This is now obliterated by the progress of enclosures.

'The chief river in the Rugby district is of course the Avon, which receives the Swift from the country near Lutterworth. Parallel to the Avon, but at the other side of the Rugby ridge, runs the Leam, which rises near Marston and receives Rainsbrook, the brook just below the cross roads, about two miles from Thurlaston. I have seen, somewhere or other, that on the high ground near Naseby four rivers rise, but in the ordnance map I can only see two of any importance;—one, Callender Brook, proceeds in a south direction, and the other, Lee Brook, towards the east. A small stream in the S.E. flows into the Cherwell, below Banbury, in Oxfordshire, and thus ultimately gets to the Thames.

‘The chief plains extend from Dunsmore Heath to Edge Hill, which is drained by the Ichene, which ultimately falls into the Leam near Frankton, and from Hillmorton to near Crick and Yelvertoft. There is one coalfield in Warwickshire with an average breadth of three miles. The chief pits are between Nuneaton and Coventry.

‘There are no large woods about Rugby, though the country might perhaps be called well wooded from the great number of trees scattered throughout the hedgerows and on the road sides. There are however some moderately-sized plantations here and there, and at Combe Abbey a wood of older growth. There are no waste places, such as heaths, &c. near Rugby, though there are several which are called Heaths, such as Lawford Heath and Dunsmore Heath, beyond Dunchurch. I suppose that all such places have been long since enclosed owing to the progress of cultivation.

‘I think that I have now described roughly the most prominent features of the country near Rugby. If there is anyone who wishes to go further into the subject, I should advise him to get the four quarters of the one-inch ordnance survey sheet, which includes the district round Rugby. They really make you understand the nature of the country directly, like a picture would, and I don’t think anyone provided with them could possibly lose his way anywhere.

‘The Sketch Map* (Plate I.) is exceedingly rough, and is only intended just to show the relative positions of some of the localities that have been mentioned.’

---

* This map has been prepared for printing by H. Ricardo.

MEETING HELD APRIL 8:—*Donation:* Eggs of Apteryx Oweni, by Mr. G. Sale, (O.R.); Fossils, chiefly fishes from the Devonian, by the Marlborough Natural History Society; Fossil Ferns and Fishes from the Coal Measures of Staffordshire, by Mr. Dutton.

F. R. Hodgson, (member), read a Paper on '*The Domestication of Parrots.*'

Mr. Hutchinson read a Paper on '*The Sun,*' illustrated by photographic views of the late Eclipse, shown by means of the oxy-hydrogen light.

MEETING HELD MAY 20:—*Exhibitions:* Veronica triphyllos, from Norfolk, by Mr. G. M. Seabroke; Salix triandra, Menyanthes trifoliata, from Frankton, by J. Armitage.

Mr. Wilson read the following Papers:

'*Note on a Boulder lately discovered in Cosford Valley, and a Conglomerate Boulder in Brownsover.*'

'It is probably known to most of the members of the Society that there are found lying scattered over this neighbourhood blocks of granite of kinds exactly identical with the Leicestershire granites, or, more strictly speaking, syenites of Mount Sorrel, Markfield, and Grooby. These blocks are called boulders. There can be no doubt that they were carried from the Leicestershire hills by ice at a time when this country was submerged, and these hills stood up as islands in a glacial sea.

'The largest boulder yet discovered, as far as I know, in this neighbourhood is in the grounds of A. Boughton Leigh, Esq., of Brownsover, and its discovery is due to his acuteness. He heard that in ploughing a certain field in Cosford valley the plough used to strike on a rock at a particular part of the field. He suspected a boulder, and requested the farmer to point out the spot. The farmer, fearing that the squire meant to make a lime pit, or a coal mine, or a digging of some sort in his field, promptly forgot where the spot was: but Mr. Boughton Leigh reminded him by a threat that he would plough up the whole field next day if he did not find out the boulder. It was conveyed to Brownsover grounds, where I have been requested to examine it. It is of syenite, quite unweathered, fresh as it was dropped from its ice raft. It weighs about 35cwt., and is roughly oval in shape. One projecting edge shews marks of the ploughshare: and one face is very decidedly smoothed, and slightly but clearly striated. There can be no doubt that it is a glacial erratic from Charnwood Forest.

'Close by it lies a large boulder, of some 10 or 12 cwt., of conglomerate. It closely resembles the finer quartzose conglomerate of the Devonian period, and suggests the Forest of Dean as its home. This should be inspected by some more experienced geologists. Few of our drift stones have come from that quarter, and it is therefore a specimen of remarkable interest, to which I wish to call attention.

'I may mention, with respect to these and similar boulders all over England, that it is eminently the duty of local societies to notice and record their existence. They are rapidly disappearing before civilization, being used for building stones, for kerb stones, for breaking up for the roads, and similar purposes. Close by the two boulders above described lie a number of boulders of greenstone and syenite, which came from the foundation of a farmhouse in the neighbourhood, and had once obviously been boulders.'

'*Note on a newly-discovered Oolitic Drift at Brownsover.*'

'I have described in previous communications to the Society the principal drift deposits in this neighbourhood, and may be allowed briefly to recapitulate them in order to shew the connection between the newly-discovered drift and the old.

'We have, in the country round Rugby, plateaus intersected by valleys. On the slopes and running back to the top of the plateaus is a deposit of a very mixed character; sometimes it is sand, almost pure, as at Hillmorton; sometimes clay, blue or red, mixed with sand or stones, nearly always characterised by chalk pebbles, well striated. This is what is exposed at the bottom in the excavation for the School gymnasium. This is the glacial drift.

'Lying over this, spreading over the whole country round, with various thickness, forming the basis of the surface soil, is a drift of gravel, consisting partly of chalk flints, partly of pebbles of Permian and carboniferous and metamorphic rocks. This may be seen at the top of the section at the gymnasium. This is the northern drift.

'Lastly, in the valleys is a deposit of alluvial soil overlying all: in some places it rests on deep sand washed into the old valleys, as at Hillmorton: in other places on the northern drift, and again in others on the lias clay. It is still being added to, the result of rain and floods. This is the alluvium.

'The new drift deposit is probably an upper member of the glacial drift, but differs widely from it in several points. I will first describe its distribution, as far as I know it at present, and then speak of its contents.

'On the road to Lutterworth, when you have passed through Brownsover, and are at the top of the hill, there is about a mile of nearly level road to Coton House. Half-way is a farmhouse on the right of the road. Opposite it, on the left, is a gate and field road at right angles to the main road. Follow this through one field, noticing as you do so the stones on the road and field. They are a mixture of both drifts, with a large admixture of oolitic stones. In the next field, close to the road, is an excavation about six feet deep containing stones almost white, like chalk. They are stones from the lower oolite, with the peculiar structure and containing the peculiar fossils of that formation. You will see the northern drift lying over this mass of oolite, and will be able to get from it characteristic pebbles. Next comes a band of blue clay, belonging, I think, to the deposit below, in which our Secretary discovered some fragments of what appeared to be, and have proved not to be, red chalk. But it is this deposit of blocks of oolite that is so surprising.

'If you follow the road a hundred yards further you pass through a farmyard into a cornfield, and there is a still better lime pit, the bottom of which is occupied by water, and by its side are at present a number of stones thrown out of the pit, ready for removal to a kiln Mr. Boughton Leigh has built for the sake of burning this oolitic deposit into lime. In this pit you may see (1) the northern drift, (2) glacial sands consisting of rubbings and waste of the new red sandstone, and (3) the oolitic deposit having a very uneven surface, unstratified, and shewing very clearly that it has been exposed to lateral pressure. The presence of water indicates a basin of clay filled by drift.

'An examination of the stones will yield the collector in a short space of time a good harvest of fossils. I have here some specimens of corals of the genera *Thamnastrea,* and *Isastrea,* crystallized as you will see internally, and shewing only traces of the sections: some beautiful specimens of *monotis;* the osseous plate of a ganoid fish; pectens, cyprides, gervillia, and other shells, besides perfect specimens of oolitic structure. There is also to be found a veined sandstone, rich in iron, shewing rings formed by chemical segregation.

'Now it must be remembered that this deposit is unique in this neighbourhood; oolitic pebbles are found in the glacial drift elsewhere, but here they compose the whole mass of the drift.

'The first impression it produced on one who examined it was that it was an outlier of oolite, a portion of the undisturbed oolite which had somehow escaped denudation. The map which I exhibit will shew that such outliers do exist not many miles east of Rugby. This is possible only on the supposition that there are faults round it by which it has been thrown down so as to seem to rest on the lower lias. The accompanying diagrams will make this plain.

'There are no proofs of the existence of this fault, and I do not accept this explanation. It is much more probable that it is a glacial deposit. There is no appearance of stratification, but much of disturbance. It lies on the slope of a hill, precisely where glacial phenomena in this neighbourhood are best seen. It resembles oolitic drifts from the Cotteswolds in the Severn valley. The difficulty is its remarkable purity. But this is not insuperable. In our last number is a note sent us by C. S. Taylor, Esq., on a similar outlier of chalk, in Rutlandshire, being the nearest mass of chalk to us, and in reality a glacial deposit of exceptional size and purity.

'Let us indulge for a moment in picturing the scene. Ages ago we know that our climate was very cold, as cold as the north of the Baltic; England was submerged over more than half its area. The Leicestershire hills of slate and syenite, parts of the oolitic range of hills to the east, and of the more distant chalk wolds, stood as islands out of a wintry sea. The broad backs of our hills were banks submerged beneath the sea. The tides and currents set up and down the deeper channels which now form our valleys. From the flank of the oolitic hills, then an ice-bound coast, a detached ice floe, laden with masses fallen on it from the cliff, floated off as spring came on. Winds and currents guided it through the channels, and at last it struck on a mud bank, and the summer sun melted the ice, and the stones were piled on the mud. The mud bank was Brownsover Hill, and the stones were these before us. There is another deposit, scarcely less interesting, about three hundred yards to your left when you have passed through four gates on the road from Brownsover to St. Thomas's Cross. It is an excavation in a sloping field, and exhibits a section of stratified oolitic drift, sloping at various angles. There are belts of sand in it, and everything indicates a shore deposit. From it may be collected a considerable variety of pebbles and fossils; among which may be noticed especially some red stones, which our Secretary has shewn to be red chalk.

'It appears to me to be a portion of an old sea beach, probably formed under the ice foot in the glacial age.

'It will be of great service if the geologists of this

Society will make themselves acquainted with these pits, and be on the look out for similar pits; and fields in which the stones on the surface resemble those in this field. Several fields in this neighbourhood yield oolitic stones, and it is not improbable that the oolitic drift is more extensive than we at present know. Also a collection of fossils and specimens from these pits may serve to shew precisely from what point in the oolitic range they were brought.'

A. M. Worthington, (member), then gave a short lecture 'on the Planet Jupiter,' and concluded by reading the following Paper.

' *On some Drawings of Jupiter, exhibited to the Society, May* 20, 1871.'*

'The drawings of Jupiter which are going round are arranged in the order they were taken. The first one is dated September 7th, 1870; the last May 1st, 1871. The greater number of them (there are 17 in all) were taken between September and February. The instrument used was a five-inch achromatic equatorial, and the powers used were from 135 to 452. The most remarkable features of the drawings are

'(1) *The diagonal belt* which appears in the 1st drawing on September 7th, 1870, and also in the last but one on February 23rd, 1871, and is also seen in many of the intermediate drawings.

'(2) *The breaks, or festoons* as they have been not inaptly named from their appearance, in the dark central belt of the planet. These markings have been subject to considerable change in shape, but in all the drawings the central belt is more or less broken by them.

'(3) *The colour of the various belts and markings.* The north-pole always appears of an ashy blue tint, sometimes more noticeable than at others. Then comes a bright belt of uniform thickness and colour, being of a very bright whitish yellow. The next belt as we go south is narrow and

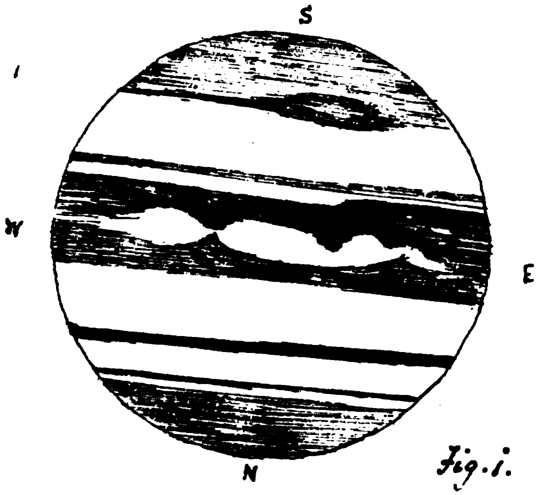
---

* See Plate II.

Plate II.

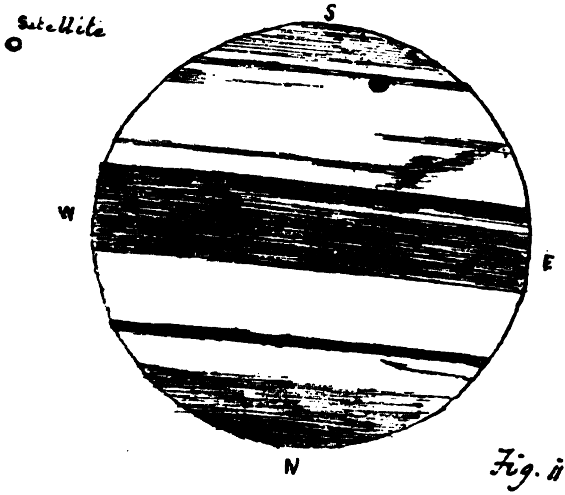
Jupiter

1870-1



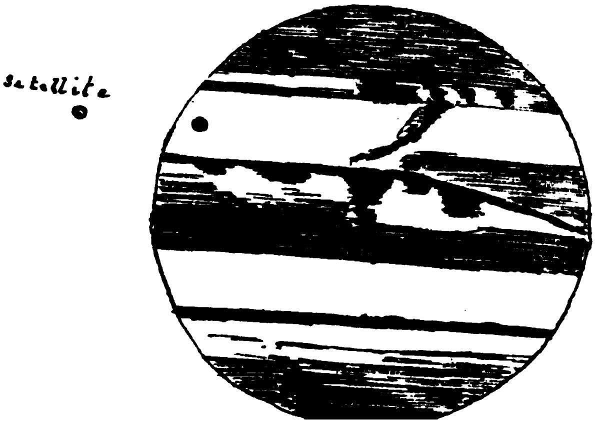
Nov. 25th
10h·30m p

Fig. i.



Jan 12th 187
8h·0m P.

Fig. ii.



Jan. 20th 1871
7h·5m p.m.

very dark, being the darkest portion of the disk. Some parts of it seem darker than others.

'Then comes another bright belt of the same yellow, white as before, and then the great equatorial belt which has a decidedly reddish tint; this belt is the broadest of all, and seems the most changeable. Above it is a narrow streak of light, and then another reddish belt not usually so dark as the central one. The south pole is generally blue, like the north pole, but not so deep in colour.

'From the drawings made on the spot at the telescope I have made another, which is a representation of such markings as have appeared so frequently within the time mentioned as to render it pretty safe to say that they were there the whole time, although they may have suffered some modification and alteration in shape. The two most remarkable drawings were taken on November 25, at 10.30 p.m., (Plate II. Fig. i.), and on January 20, at 7.5 p.m., (Plate II. Fig. iii.) The definition was on both occasions exceedingly good, and allowed a great deal of fine detail to be seen.'

MEETING HELD JUNE 3:—*Exhibitions:* Adder's Tongue Fern, from Barby (new locality), by F. R. Hodgson; Monstrosity of Cabbage leaf, forming a pitcher, by Mr. Wilson; Emu's Egg, from Australia, by C. M. Chadwick.

E. Burchardt, (member), read the following Paper on '*The Cold Week in May.*'

'It is a curious fact that the week extending from the 8th to the 15th of May is sure to be colder than the one before or after it. Many scientific men have observed this, and all have fixed the date of this fall of temperature at about the same part of the month; namely, somewhere between the 8th and the 15th; the greatest cold generally occurring on the 11th. But though it was left for science to fix by observations the exact date of this, we have abundant proof in the proverbs of several countries that it was long ago observed and very generally established as a fact; and in these cases the evidence of proverbs is often very valuable, as they are often founded on long and general observation. The Scotch have a saying,

> "Ne'er cast a clout
> Till May be out."

The French say, "In the middle of May comes the tail of winter." The Germans have a proverb to exactly the same effect; but they also have one which runs, "He that shears his sheep before Servatius' day loves his wool more than his sheep." Now Servatius' day falls on the 13th of May, and it is interesting to find that he and the other three saints, whose festival days run from the 11th to the 14th, are called in some parts of Germany and Holland "Eisheiligen," or "Eismänner," that is, frost saints or frostmen, because they are believed to bring cold with them. There are also in Italy several proverbs relating to this cold week in May, but I have quoted enough to show that it has been observed so long as to pass into a common saying, not only in northern latitudes, but even as far south as Venice and Milan.

'When Captain McClintock was in the Arctic sea, searching for Sir John Franklin, he noticed that this fall of temperature took place in the extreme north also. In his "Journal of the Search for Sir John Franklin" this is an entry. "May 10th, 1858. On the morning of the 8th we left Holsteinborg with a pleasant land wind and bright weather. When 15 miles off shore we were stopped by ice formed in the night, the thermometer having fallen to 12°." But on the 14th, "Summer has suddenly burst upon us, thermometer up to 40°."

'On May 16th, the year after, he says, "We have not had a single clear day since the beginning of the month. Temperature at zero."

'The average temperature of May exceeds that of April by about 7°. June exceeds May by 6½°, in England. Between no other two consecutive months does the average temperature differ so greatly, except between October and November, when it is 7°, and September and October, when it is 6°. Since then the average temperature of May is so much above that of April, the thermometer ought to rise during May. And so it does, excepting the week from the 8th to the 15th, in which it invariably falls.

'Before going any farther, I had better explain how these charts are kept.

'The chart exhibited is an enlarged copy of that in the glass case near the barometer in the New Schools, and is divided by perpendicular and horizontal lines into a number of squares. The upright columns, made by the perpendicular lines, stand for days of the month, and, at the top of each, is put the day it stands for.

'The horizontal lines stand for degrees Fahrenheit, and are numbered accordingly. So that, when we wish to register the temperature for any day, we put a mark on that part of the day's column which answers to that temperature. Then, we join the dot, by a line, to the one made the day before, and so, day by day, we draw a line which rises and falls as the temperature does, and shows us at a glance the variations of the temperature much more clearly and expressively than any register of figures can.

'At Kew, and other stations of the meteorological office, the rising and falling of the temperature is registered, by photography, all day; so that by examining the chart we can tell what the temperature for *any* hour of the day was. Here, however, the readings are taken at 8.30 only, the four thermometers kept being (1) the dry bulb, (2) the wet bulb, the bulb of which is kept constantly damp, so as to show what the difference of temperature produced by the evaporation is—for evaporation is always attended with cold, as anyone may easily prove by wetting his finger with ether, or spirits of wine, or any thing that evaporates quickly; (3) the maximum, which shows the greatest, and (4) the minimum, which shows the least, temperature in the last 24 hours. The greatest temperature generally occurring the day before it is registered, and the minimum the night before. On the chart in the New Schools, the upper black line represents the maximum, the red line the dry, the blue the wet, and the lower black line the minimum.

'The cause of the sudden cold in May is some body that comes between us and the sun, and so shuts off its light and heat from us. As it cannot be seen with a telescope, it must be a cloud of small bodies, not a single one. It must be moving, or else it would soon be drawn into the sun by attraction. Its orbit cannot be in the same plane as ours, or else it would always be between us and the sun. It is, therefore, inclined to our orbit, crossing it at the part we are on the 11th of May. But, to cause a cold week every May, it would have to reach that part of its orbit which crosses ours on at the exact time when we reach that part of our orbit which it crosses.

'And as this would be a most unusual coincidence, it must be *always* crossing that part of our orbit. The only solution is that it must be a ring of small bodies, moving in an orbit like the earth and planets. A ring turning round the sun, as the tire of a wheel round its axle.

'But, if this is the case, why do we not have one week in November colder than the others? for the earth would reach in November that part of its orbit opposite to that which it occupies in May, and the ring would again cross between us and the sun. The reason is that this time it crosses our orbit outside, being looped into it, so as to pass inside it between us and the sun one time, and outside, so as to have us between the sun and it the other time.

'And though we have no cold week in November, as we have in May, we *have* showers of meteors on the 14th. And these meteors are now known to be the bodies which obscure the sun in May, and which cross our orbit again in November. In 1866 these November meteors were seen very beautifully, in far greater number than in other years. The reason for this is that the ring of meteors is thicker in some parts than others, and in that year we broke through the thickest part of it. The period in which these meteors perform one revolution is 33¼ years.

'This is the probable cause of the cold week in May. But there is one thing still wanting. These meteors have never been *seen* crossing the sun. Although everything tends to prove that they *do* cross the sun in May, they have never yet been seen. This is easily accounted for when we remember that, supposing them to be the same as the November meteors, they are very small. And a cloud of small bodies crossing the sun would be detected only by its power of shutting off the light and heat from us, and throwing us into its shadow. Still it would be more satisfactory if it had been seen. Therefore every May astronomers are on the look out for it, but, so far, unsuccessfully.

'Not long ago, Herschel saw, in India, some objects, visible only with a telescope, crossing the sun, and darkening it. They moved steadily across in great numbers, all going one way, except one, which suddenly turned off at right angles to the rest. As these bodies seemed to be exactly what he was looking for, except that one which turned away from the path of the rest, he naturally thought that he had seen the bodies which cause the cold weather in May. But, with many others who were exulting over this great discovery, he was to be disappointed. For shortly afterwards he found that what he had seen was a large swarm of locusts flying at a great height above the earth, which afterwards settled in the north of India. And so this cause of the cold week, although known to exist, still remains to be actually seen in the act of shutting out the light of the sun from us.'

A somewhat long discussion followed this Paper; the thermometric chart for the last month was exhibited to prove that the second week in May had been considerably colder than the weeks which preceded and followed it. Mr. Kitchener confirmed the existence of the cold week by refering to previous thermometric records.* Mr. Wilson remarked that, unlike the meteoric ring, which we intersect in November, this ring must have its nodes stationary, or nearly so, and expressed a hope that the Society would in future years make use of the thermopile, to examine into any changes in solar radiation during that week.

---

* In 1865, 66, 67, 69, 70, and 71, the week May 9—16 was colder than the average of the month, in some years by as much as 5 or 6 degrees: in 1868 the cold week seemed to be a little early, beginning on the 6th.

Mr. Sidgwick exhibited living specimens of the Wasp Hawk Moth, and spoke of the theory of Protective Mimicry as illustrated by them.

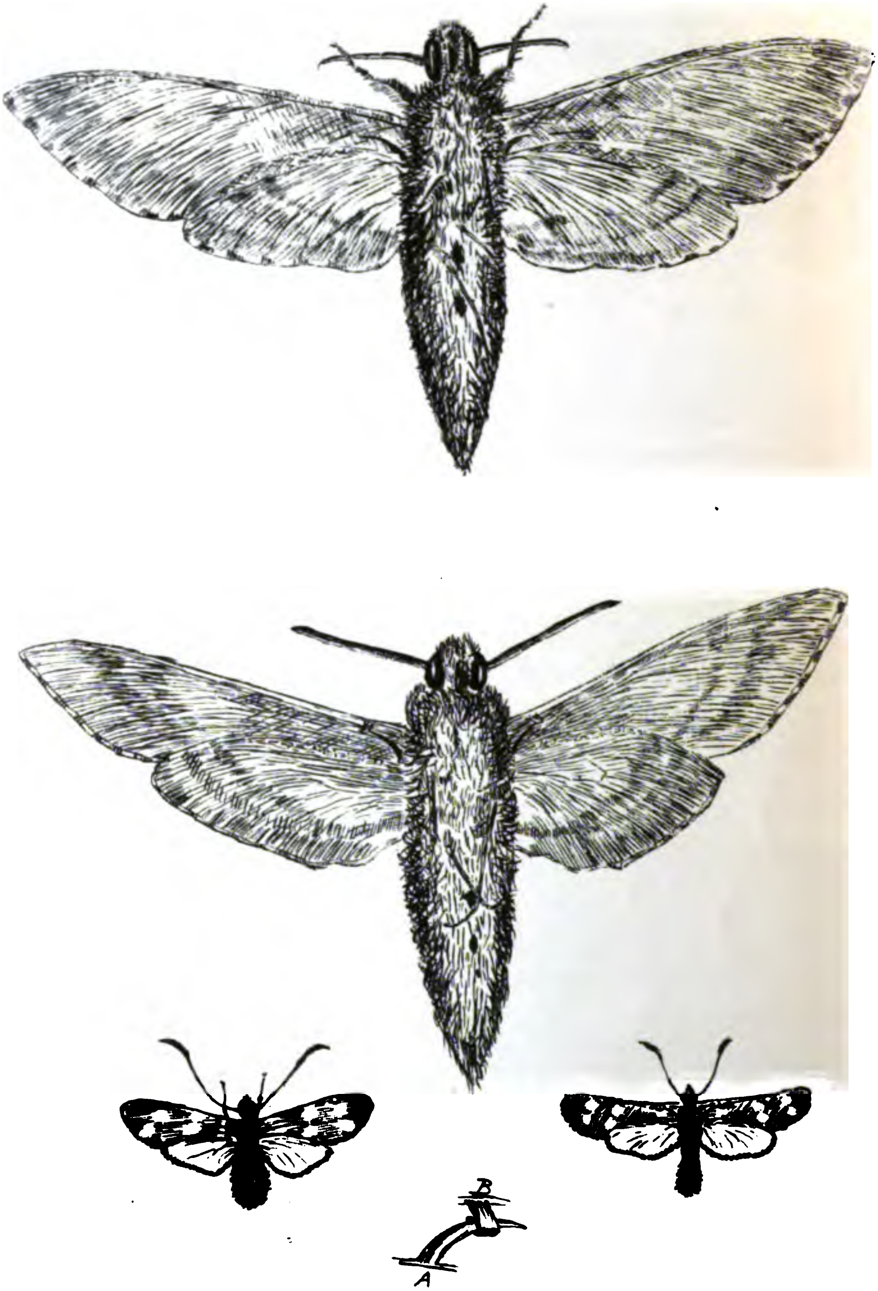
MEETING HELD JUNE 10:—Mr. Wilson gave a sketch of the Geology of Charnwood Forest, and of the route to be taken on the next Field Day.

FIELD DAY HELD JUNE 17:—The Society, under the guidance of Mr. Wilson, went to Charnwood Forest, and visited in succession Mount Sorrel granite quarries, where they were hospitably entertained by C. H. B. Hambly, Esq.; Swithland slate quarries, where they were received by A. Ellis, Esq.; Beacon Hill; the Monastery; and Bardon Wood.

MEETING HELD JULY 1:—*Exhibitions:* Eggs of Woodpecker, by C. M. Chadwick; Varieties of Italian Marbles, by Mr. Hutchinson; Trifolium striatum, and Lithospermum officinale (new), by H. G. Wauton; Gum exuded from Cape Pelargonium, used by the Kaffirs for illumination, by Mr. Moberly; Ustilago antherarum, by the President. *Donation:* Collection of Rubi and Lichens, by the Rev. A. Bloxam, (hon. mem.)

A Paper was read by A. G. Burchardt on '*The Various Stages of a Frog's Life,*' illustrated by preserved specimens in various stages.

PLATE III



S. Convolvuli ♀ ♂   Z. Filipendulae

MEETING HELD JULY 15:—*Exhibitions:* Rook Pellets from Chapel Wood, by A. Napier; Echium vulgare, from Lower Hillmorton, by F. Wise. *Donation:* Aristolochia clematitis, from Godstowe Priory, by A. F. Northcote.

Mr. F. R. Smith, (corr. mem.) then read a Paper on '*A Visit to Some Alkali Works.*'

The following Paper was then read by D. A. Ogilvie, (member), '*On the Hook in the Wings of Male Sphinges.*'

'To the ignorant animal zoology perhaps seems the most attractive branch of natural history; and so insects became my special amusement, probably because they are more manageable than the larger forms of life; and then I went a little deeper and found that the lepidoptera were much to my taste, and still deeper, and I finally rested with wonder and amazement before the Hawkmoths, or Sphingidæ.

'Now one cannot help noticing a very curious circumstance in these moths; the upper and lower wings of the moth are connected together by a "hook and eye" apparatus, a phrase which I use not because it is elegant, but because it is expressive, and for want of a better one. The first time I saw this "hook and eye," I really—I may say actually—fancied I had made a discovery. But of course it proved nothing but fancy, for when I looked in a scientific book—laying aside the popular books on natural history for the moment—I there found some of the lepidoptera enjoying the name of Chalinoptera, which being interpreted is bridle-winged; by straining the metaphor a good deal one finds that it implies that the upper and lower wings of the moth are bound or bridled together. Two terms are here unavoidable; the "thorax" of a moth is that portion of the body of a moth which connects the head with the abdomen; the upper margin of the wing of a moth is called the "costa."

'Now there is a slight variation—I use Mr. Darwin's term with all possible respect—in the "hook and eye" apparatus; for in the male specimens it is well developed, but in the female merely rudimentary. The converse of something similar to this may be seen in the higher animal, for the male has only the traces or rudiments of the mamma which in the female are perfectly developed. But to describe more acurately what is the case in the male and female moths. In the male (see Plate III.), on the under surface of the lower wing, from the main nervure, adjoining the muscles which move the wing, there puts out a thin tapering spine as pliant as fine iron wire; this forms a graceful curve upward on the plane of the wing; this spine or "hook," as I have improperly termed it, is thrust into a catch or "eye." Now this catch rises from the under surface of the main nervure or costa of the upper wing, so that when the "hook and eye" are in gear—so to say—the upper and lower wings are always neatly kept in the same plane.

'In the female specimens the spine juts out from the main nervure of the lower wing, as in the male; but it is weak, shrivelled, short, and often divided so that it presents the appearance of one or two horse-hairs coming from the thorax of the moth; moreover there is no catch, nor trace of any on the main nervure of the upper wing; so that, logically speaking, the tuft of horse-hairs, the would-be spine, is of no use at all to the female.

'There are more ways than one of explaining the existence of the "hook and eye," and perhaps this arrangement is to enable the males to guide their flight, and to make it strong and steady, and specially to keep the wings flapping in unison. But then we say the females need the contrivance as much as the males. This is hardly the case, however, for the great object of the males is to keep up their race; and all they try to do is to find a mate, and so the male moths vie with each other, and those that have the greatest speed, that can use their wings to the greatest advantage, are most likely to get at the object of their admiration. I use the word "vie," because I believe there are about seven males to every five females; hence the children would have the characteristics which served their father so well, their children would again inherit it, until the peculiarity became perfected: this is one poor instance of "Natural Selection."

‘On the other hand, the female needs no *swift* flying apparatus; all she has to do is to lay her eggs; she is always near the plant on which her progeny will thrive, and her task is only to flit about among the leaves of this shrub and there lay her eggs, her many eggs; so she has a large, robust abdomen capable of holding them; her wings are proportionally large—I venture to say clumsy—when compared with those of the male; and least of all does she require the “hook and eye.”

‘Some female moths (C. Brumata) go so far as to dispense with wings, retaining only their rudiments. Others, again, possess that which their mates have in perfection only to a slight degree; for instance, the “long horn” (De Geerella) female should rightly be called the short horn, for its antennæ are not one-quarter the length of those of her mate.

‘Sphinx Ligustri;	hook well developed in male, rudimentary in female.
‘S. Tiliæ;	ditto.
‘S. Acherontia;	ditto.
‘S. Ocellatus;	not plain in either male or female.
‘S. Populi;	ditto.’

MEETING HELD OCT. 5:—Exhibitions: Cuscuta epithymum, (new to Rugby), by the President; Photograph of a Moa, by Rev. A. Bloxam.

Mr. Hutchinson exhibited and described specimens of Lepas anatifera.

Mr. Spurling exhibited living specimens of snails from Stonefield, in Oxfordshire, from the neighbourhood of a Roman Villa, where an edible species of snail had become naturalized ever since the Roman period in Britain.

Mr. Sidgwick read an account of his descent this summer into a Salt Mine at Salzburg, in the Tyrol.

Mr. G. M. Seabroke (corr. member) then gave some account of his observation on the direction of the rotation of cyclones in the solar atmosphere; see page 6.

MEETING HELD OCT. 21:—*Exhibitions:* Collections of Lepidoptera by H. A. Bull, F. W. Dutton and A. F. Buxton; two specimens of Deïopeia pulchella, caught this summer, by A. F. Buxton (only a very few specimens of this Moth had ever been caught in England before).

The Society having offered a prize for Papers shewing observation and originality, the prize was now awarded to the following Essay by H. Ricardo, (member).

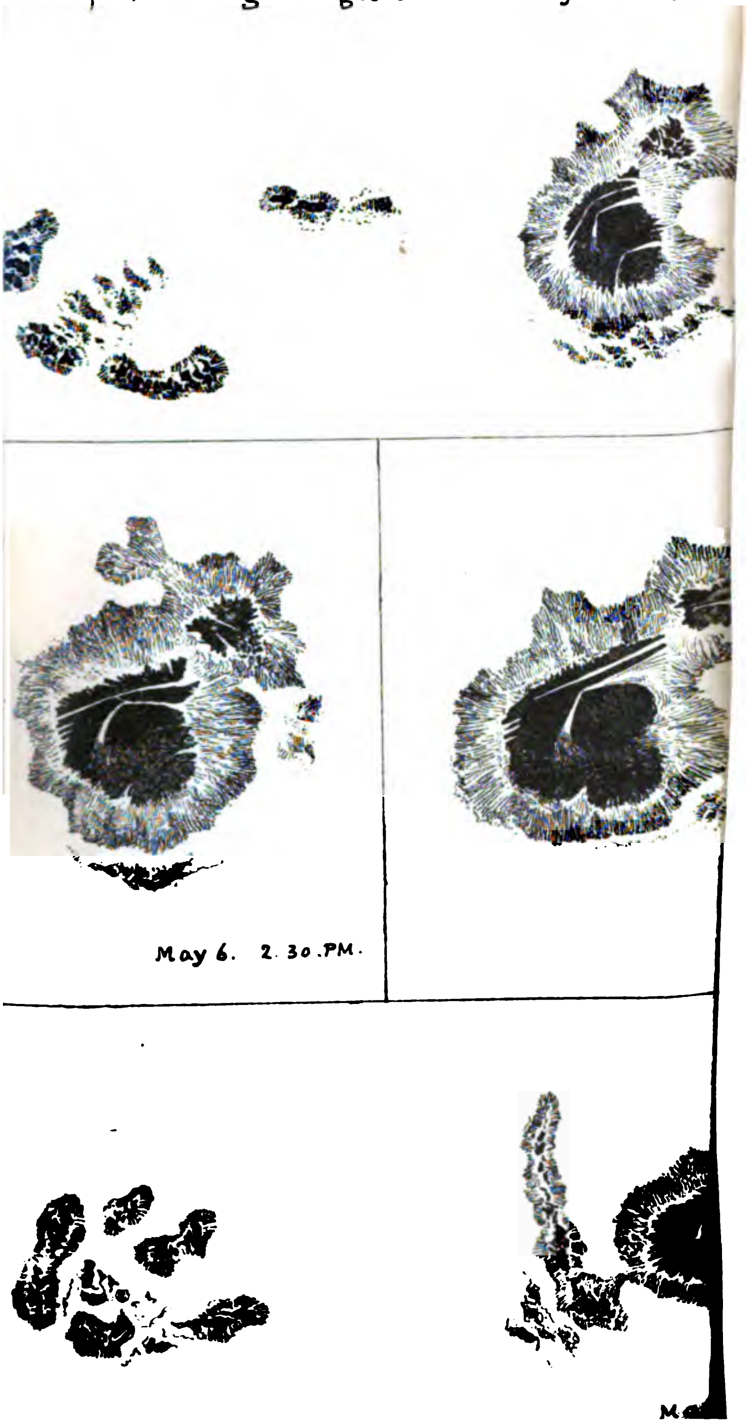
'*A Supposed Correlation of the Eye and Ear.*'

'When I first entered this School, now nearly three years ago, there were to my knowledge only two in the whole School who wore spectacles. I need hardly remind my critics that the number is considerably increased now. Whether it is the fashion to cultivate short-sightedness and wear eye-glasses and so forth now, or no, I won't pretend to say. When I first came here I noticed some whose eyes were different from the general run, and, on inquiry, I learnt that they were short-sighted. How different, I do not think I can explain, as I don't know exactly how it is; but I can always pick out a short-sighted person from a large group merely by his eyes, as easily as I can tell what house he is in. In these cases the eye is generally large, deeply set, and prominent; and, as a rule, a person with spectacles is generally above the average of school ability. According to phrenologists, large eyes denote ability for learning languages, provided that the eyes be not *too* large. The owner of these eyes, as everyone knows, has generally a stooping posture, and when he wants to read he raises the book up to his face, and besides that declines his head, which is slightly superfluous, to meet the book. They generally when looking at objects half-close their eyes, as if to exclude the superfluous light they seem troubled with. Well, I was not long noticing this, and I then turned myself to see if I could read their characters, &c. by any other members. Noses I tried, but they were so various; mouths I felt were beyond me, their constant changing making them very hard to read; then came the ears. There, setting apart all minor differences, I classed them in two divisions of "Big Ears" and "Small Ears." But, you ask, "How do I measure them?" Not with a foot-rule certainly. I do not 2½ inches, or such a measure, and measure all ears according to that. It is generally allowed that in a perfect or ideal face the ear is as long as the nose, and if we draw two parallel lines from the top of the nose and from the bottom, we shall strike the tip and end of the ear.

'On looking superficially at the ears of people we exclaim, "Oh, there's not much difference." No, there is not much apparently, but in reality there is a great deal. According to Darwin's theory, our ears are just the ordinary ears of a beast, such as a horse, folded inwards, and generally at the top or near the top of the ear on the fold, helix, as it is called, there is a little excrescence supposed to be the end of the ear which protruded after it was folded up. Well, I was struck by the different sizes of the ears. There was one whose ear was fully ⅛ of an inch below the required size, and another quite ¼ above. These sound at first insignificant distances, and the result of imagination and not measurement; but it is not so; and, if any of you were to try it, you would be surprised at the difference 1/16 makes. Then, again, the position of the ears varies very much; when they lie close to the head you may pretty surely judge the owner to be deaf, and vice versâ. How I found out the connection was as follows. I was in the same form as another boy who was suffering from weak eyes. His ear was peculiar. All the top fold or helix was, as it were, frayed out, and the little tip very plainly marked on the edge. The ear was not small, but had this peculiar appearance.

After a while I saw another ear like this, and I asked him, —not the ear but the possessor thereof,—if he had weak eyes. He told me very kindly that he had not, and hoped he never would. Then, thought I, this ear is not a sure test. I next singled out one who had an extremely small ear, and who did not wear spectacles. I had not seen him before, but I could not help saying to myself, " That fellow is as blind as a bat." I enquired, and the result was satisfactory—to me at least. I then began spotting out all owners of small ears, and watching them closely. I was amply repaid for my trouble. Exceptions there were, but these "exceptions prove the rule," and these are very few; and I am able to tell you certainly now that out of 30 there are only 3 who possess small ears and have good sight. I have made these investigations not only at the school, but at every opportunity, and I very seldom have to retract any statement I have made about their eyes. I need not tell you, I am sure, that it is through the lens inside the eye not being sufficiently convex that short-sightedness is produced, but I have never heard of the eye and the ear being in any way connected, in fact, I think I have heard it contradicted that the eye has anything to do with the ear. Yet we know that very often a lady who has had her ears pierced has had her sight considerably impaired. I know of two cases, one where it cured and one where it did great harm to the eye. Again, have any of my readers ever been down in a diving-bell? The sensation there is peculiar. I have undergone it once. The pressure of the air on the ear is so great that it causes that unfortunate member to sing as if it contained a hive of bees, and the eyes swim and objects appear double. Yet we often hear of the eye being affected without the ear. Take, for instance, this one. A person in a state of insobriety sees double, yet it has never been remarked that he is in the slightest deaf. What then are we to conclude? It seems, then, that the eye and ear are connected in some way, whether materially or sympathetically I can't say, as it seems that the eye and ear are besides independent of each other as well. On the other hand, if I am asked what becomes of

Sun Spot, shewing changes between May 6th – 8th. 1



?

the "Big Ears," I say that I have not yet worked them out; but I say this, that a large ear, as far as I have yet ascertained, does *not* seem to indicate long-sight or short-sight. But of that I cannot speak definitely; but what I have said now is the result of two years' investigations, and are facts and not theories, and are open to all who wish to enter on this field, which is a most interesting one.'

The Society's second prize had been awarded to F. R. Hodgson, for a Paper on '*The Observation and Use of Pets,*' which was now read. The Paper related the past history of a series of pets of all sorts, with observations on their habits. From this Paper the following extracts are taken.

'Pets may be used, and may be abused. In order to *use* a pet, that is, to observe its habits, and learn its uses, there is no need to keep it always in confinement: sometimes it is better not to do so. One may observe the habits, and learn the uses of most English animals and birds, by giving time and care to watching them in their wild state, and learn much more from such observation, than when the creature observed is kept confined, a state to which it is unaccustomed. * * *

'I have kept many pets at different times, in fact I can hardly remember the time when I had not a pet of some sort: some of them, I hope, I have used; some of them, I fear, I have abused.

'We had a great number of cats which were petted all day and hunted rabbits all night; I suppose we ought to have clipped the tips of their ears, and then they would so have disliked getting the wet and dirt into their ears, when going down the rabbit holes, that they would have given it up; but we didn't, and they most of them came to an untimely end, getting either trapped or shot, and one poor little kitten got its eyes pecked out by a malicious tame jackdaw.

'These jackdaws were a great plague. There were, I should think, over a hundred of them always about. They inhabited chiefly a very fine old walnut tree, about 10 yards from our house. They used to do incalculable damage in the garden, for they would pick out all the peas which the gardener had just put in the ground, and if by any means we succeeded in raising any, they would rifle the pods of the grown-up plants; and in the winter they picked up all the crocus and other bulbs they could find. They sometimes too built in our chimneys, and would now and then tumble down into the rooms, so that to find a jackdaw's nest in a grate was quite a frequent occurrence. It was impossible to shoot them, they were so cunning; if you went to the walnut tree on one side of the house, they would all fly up out of range to the church steeple on the other side; and if you went there, they would either get inside it, or come back to the tree. We used to get some of their eggs out of holes in this tree nearly every year. It was tenanted by jackdaws, starlings, and one old pair of owls. * * *

'I had a tame owl once which I bought at Rugby, and took home with me. When we first got him, he used to make a hissing noise at night, very like the noise a cross schoolmistress makes in enjoining silence on noisy children, "sh-h-h." Afterwards he hardly ever made any noise, unless he was startled or teased. We used to get scraps of liver, &c. from the butcher to feed him with, and a mouse or small bird when we could. He preferred eating at night, but he would eat in the day-time if he was hungry. The mice he took down whole, beginning with the head; and often the tail would hang out of his beak for some time afterwards with a very ridiculous effect. He used to stand on his meat, and peck great shreds off from between his claws. These claws were very sharp, and used to stick into my hand sometimes when he was perched on it, and thought he was going to fall; but he never intentionally pecked, unless he was very much teased or frightened. He startled the cat fearfully: for whenever she came near, he stretched out his immense wings till they were about a yard across, and hissed at her; and the dog seemed to think he was a ghost. * * *

'I often tried to catch a squirrel by climbing for it, but never succeeded; but a young one was once given me which had been caught by some men in the village. It was a nice little pet while it was young. We used to carry it about in our pockets, and its chief treat was to be allowed to run up our coat sleeves, and go to sleep there. If we held a nut between our lips or in our hands, and put the squirrel on the floor, it would climb up our clothes till it got to it. We used to feed it chiefly on nuts, acorns, and bread and milk. Whilst it was young it never attempted to bite, and never seemed to object to being handled. But when its teeth had grown to their full size, he seemed to become very wild, and to bite whenever he had the chance: so that we had to put a thick pair of garden gloves on when we wanted to feed him. He often escaped, and either came back to his cage, or else to us, if we held out nuts to him in the garden. At last, when he got so very wild, we let him go for good; and when he was hungry, he used to come to us in the garden for a nut: at last, I believe, he was killed by some boys in a field. I went up to a squirrel's nest these last holidays, hoping to find some young ones: but there were none. It was beautifully lined with soft shreds of wood, with a thick covering of twigs and oak leaves outside. * * *

'We spent some time in stocking some tubs in the garden with newts, minnows, gudgeon, horse leeches, &c., which we used to catch in dykes and ponds by means of a net or basket fastened to the end of a long pole. We either thrust this quickly into the water weeds, where they looked likely for newts and fishes, or else we made a haul for a visible newt at the top of the water. The male newts are very pretty objects for an aquarium, and are very easily fed, as they will eat nearly anything, red worms being their favourite food. It is commonly reported that newts, like frogs, live on land as much as water; but I am quite sure such cannot have been the case in Northamptonshire. I never met with one on land, though all the ponds and ditches swarmed with them. And talking of newts being found on land, though more generally in the water, I remember an amusing anecdote with which I will end this Essay. It was told us by an acquaintance of ours, who used always to spend his holidays in Scotland for the salmonfishing. He told us, that once, when he was fishing in the Thurso, he saw a Scotchman wheeling something carefully covered by a cloth in a wheelbarrow towards the river. He asked what it was. " A wemenous sarpent, your honour," the Scotchman replied, " I be going to drown it in the burn." Our friend untied the cloth, and lo! there was a harmless, trembling newt.'

MEETING HELD NOV. 4:—*Exhibitions:* Collection of Eggs sent from South America, by H. N. Larden, (corr. member); Variations in Leaves of Holly, prickly and smooth, from same tree, by Mr. G. M. Seabroke.

Mr. H. Morrell, (O.R.), late Assistant Demonstrator at the Oxford Museum, presented to the School a valuable series of Zoological Dissections similar to those in the University Museum, Oxford.

Mr. Morrell gave a lecture illustrative of the dissections presented.

The dissections have been placed in the Society's Room in a case presented by Dr. Hayman.

MEETING HELD NOV. 18:—A Paper was read by Mr. R. H. Ker, (hon. mem.), on '*Sugar,*' illustrated with various chemical experiments.

MEETING HELD DEC. 2:—Mr. Wilson read a report of the observations taken at the Temple Observatory in 1871. (See page 1.)

REPORTS OF SECTIONS FOR 1871.

Meteorological Section.

Meteorological Observations.

April.

Date	Barom. Re-duced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain	Date	Barom. Re-duced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	30.027	39.8	36.4	50.4	49		18	29.648	47	47	57	42	
2	29.981	44.2	42	47	39	.01	19	29.290	52.5	52	52.5	46.8	.64
3	29.797	44.5	43.5	51	40	.05	20	29.286	45.5	43	58.8	41.2	.12
4	30.163	40.1	37.8	51	36		21	29.572	46	44.6	58.8	39	.02
5	30.075	47.4	44.8	50.8	36		22	29.742	50.5	50	53	45	.16
6	30.218	40	37.2	50.8	37		23	29.633	51.5	48	61	34.5	
7	30.252	42.7	38.8	47.5	36.4		24	29.970	45	44.4	54.8	42.4	
8	30.164	38.3	37.2	52.2	28		25	30.025	46.5	44.5	49	38.5	.15
9	30.035	44.5	37.1	54	28		26	29.976	47	45.8	53.8	42	.06
10	30.060	38.9	37	53.8	33.5		27	29.761	51.6	49.8	60	44.8	.06
11	30.082	44.8	40.8	51	30		28	29.837	53.4	50.8	59.5	44	
12	29.887	54	52	54	43		29	29.552	52.5	51.8	58.2	47.8	.63
13	30.009	54.8	52.2	61	43		30	29.824	49.4	45.4	58.2	43	.04
14	29.966	49.8	49	62	42								
15	29.233	49	49	62	42	.12	Average	29.822	47.37	44.95	54.82	40.10	Total 2.62
16	29.322	49.5	47	56	46	.46							
17	29.393	50.5	49	55.5	43	.10							

May.

Date	Barom. Re-duced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain	Date	Barom. Re-duced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	30.098						18	29.883	52.3	51.1	54.1	36.2	
2	30.153	44.6	41.8	55.4	35	.08	19	30.169	54.8	52.8	56.3	41.2	
3	29.892	49	45.8	55.3	36.5		20	30.303	52.9	51	63	41.2	
4	29.895	46.3	43.2	53.6	37.5		21	30.329	54.5	52	61	45	
5	30.144	49.8	46.1	52.1	35.5		22	30.283	56.6	50	62.8	42	
6	30.253	56.5	53.8	62	46		23	30.069	57.9	51.3	68.9	42	.01
7	30.410	54.5	50.5	68.5	41	.01	24	29.945	60.1	58.5	71.2	43.9	1.00
8	30.281	58.2	55.3	64	40.5		25	29.831	65	63.8	77.2	55	.03
9	30.217	44	42.9	74	42.2		26	29.943	51.8	50.4	66.8	45.7	.35
10	30.279	44.6	43.7	48.6	40.5		27	30.030	52.2	50.5	60.8	39.4	
11	30.190	44.8	42.5	49.1	39.3		28	30.205	49.7	49.5	61	46	
12	30.073	46.7	45.3	59.1	40.5		29	30.308	49.3	50.1	63.3	45	
13	30.069	42.1	40.7	57.5	39.7		30	30.247	55.9	53.8	64.9	42.1	
14	29.917	45.6	44	49.1	32.5		31	30.181	58.6	57.7	69.9	51.1	
15	29.913	47.4	45	55	39.7	.01							
16	29.890	50.4	49.3	57.2	44.6		Average	30.112	49.8	49	60.3	40	Total 1.50
17	30.074	46.7	46	58.8	39.3	.01							

June.

Date	Barom. Re-duced	Temperature				Rain	Date	Barom. Re-duced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.				Dry Bulb	Wet Bulb	Max.	Min.	
1	30.072	59.9	59.5	67.8	52.5		18	29.552	58.5	54.8	60.1	51.5	.06
2	30.203	49.8	47	64.4	41.5		19	29.520	58.8	55	65.2	51.7	.07
3	30.264	45	44.2	54.8	37.1		20	29.591	56.1	54.2	60	50.4	.03
4	30.075	47	46.1	53.8	42.5	.01	21	29.837	55.2	52.2	68.1	51.5	.07
5	30.219	49.1	42.6	54	36.7		22	29.936	48.7	45.8	60.9	41.8	.37
6	30.110	56.1	55.9	60.1	46	.04	23	29.869	47.2	46.9	59.7	45.8	.02
7	30.037	46.9	45.8	56.7	43.5		24	30.118	49.1	48.8	52.6	45	.03
8	30.038	46.1	45.8	55.8	40	.03	25	30.194	51	46.5	61.1	37.5	
9	29.932	46.5	47	53.8	44.2		26	30.298	50.3	46.9	60.1	44	
10	30.033	49.9	48.1	57.3	46.2		27	30.067	53.8	51.6	60.9	42.5	.08
11	30.013	50.5	49.3	61.3	45.2		28	29.636	57.3	56.2	67.4	52.1	
12	30.086	46.1	45.5	59.2	43.5		29	29.836	58.5	53.4	64.9	47.4	.04
13	29.976	53	50.2	68.1	43.7	.29	30	29.718	56.5	54.1	65.5	53	.05
14	29.892	58.7	58.2	63.8	53.6	.30							Total
15	29.879	60.5	60	67.1	57.5	1.55	Average	29.948	52.8	50.9	61.3	46.6	3.16
16	29.784	58.5	57	65.3	54.5	.05							
17	29.659	58.4	58.1	71.2	57.3	.07							

July.

Date	Barom. Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	Rain	Date	Barom. Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	29.930	58.8	54.2	68	48		18	30.098	61	58.5	72.2	52	
2	29.829	58	54.8	67.1	48.5	.01	19	29.791	61.8	59	72.6	54	
3	29.535	58	53	58.3	52.5	.30	20	29.915	59	55	75	53.5	.06
4	29.728	57.5	55	61.5	52.5	.16	21	29.957	58.9	56.1	67.5	52.4	.13
5	29.898	58.7	55	59.2	48	.36	22	29.661	57.4	57.3	63.5	55	.56
6	30.172	57.6	55	66.8	50.1	.02	23	29.631	60.2	57.2	66.8	51	.05
7	30.087	58	56	63	56	.01	24	29.679	59.5	57.1	67.2	51	.40
8	29.867	58.6	55	71.3	52	.07	25	29.391	58	54.5	66	50	.08
9	29.967	59	55	67	50	.03	26	29.372	56.8	53.5	64.6	49	.08
10	29.988	58.6	55.8	69.4	45	.01	27	29.666	57.2	54.8	65	48	.02
11	29.720	52	51.8	69	50	.65	28	29.804	54	54	71	53	.13
12	29.923	57.7	55	62	47	.02	29	29.893	59.2	58	67.2	50	.03
13	29.842	61.5	60.2	65	53	.11	30	29.577	52	50.2	65.4	47	.24
14	29.954	61	61	70	60	.10	31	29.980	62	57	63	46	.32
15	30.032	63	60.5	68.8	55.6	.23							Total
16	30.146	63.8	61.8	69.8	59	.01	Average	29.843	58.8	56.3	67	51.3	4.19
17	30.109	64.5	63.8	74	59								

August.

Date	Barom. Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	Rain	Date	Barom. Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	30.090	59.4	54.4	69	47		18	29.437	63	62.4	75	59	.24
2	30.004	60	56	69	48		19	29.828	58	55	70	52	.12
3	29.773	65	58	74.4	53		20	30.054	60	56	68	47.8	
4	29.732	57.4	54	70	53	.16	21	30.005	64.6	60	66	60	.02
5	29.937	59.6	54	68	46	.14	22	30.140	58	54.6	73	43.4	
6	30.223	64.2	59.4	69	46		23	29.903	61.4	59	73.2	53.4	.02
7	30.222	68	62.4	74.8	51		24	29.837	57	56	71	52	.05
8	30.176	59	58	78.2	54		25	29.851	61.2	56	67	52	.25
9	30.169	67	63	75	53		26	30.088	58	55	69.2	50	
10	30.172	71.2	65	81	55		27	30.434	58	53.4	69	44.6	
11	30.148	72	67	82.2	56		28	30.500	59	56	71	44	
12	30.107	71	66	84	56		29	30.258	59	57.4	73	51.6	
13	30.042	74	69	84.2	60		30	30.118	64	60	74	50	
14	30.036	62	60	88	60		31	30.105	63	60	79	52	
15	29.996	60.2	58	74	55								Total
16	30.011	60	58	78	55		Average	30.075	65.7	58.9	74.04	53.1	1.18
17	30.887	63	61.4	78	58	.18							

September.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Reduced	Dry Bulb	Wet Bulb	Max.	Min.			Reduced	Dry Bulb	Wet Bulb	Max.	Min.	
1	30.098	65	61	74.6	52.4		18	30.203	52	46.2	65.6	45	
2	30.097	58.2	55	73	54.2		19	30.140	49	45.4	65.6	45	
3	29.883	64.2	61.4	66	64	.12	20	29.996	52.6	48	55.2	47	
4	29.776	58	57.1	72	58	.22	21	29.613	50	48	61	38.8	
5	30.066	58.6	56	62	47		22	29.716	50	46	63	40.2	
6	30.040	60.2	56	69.4	45	.43	23	29.876	47	44	61	37.4	.37
7	29.978	57.2	55	64	51.2	.01	24	29.508	43.4	43	61	42.4	.08
8	29.963	51	50.2	67	44	.17	25	29.832	47	45	54.8	40.5	.20
9	29.677	53.6	53	66	50	.07	26	29.587	49.5	47.2	52.5	45.5	.47
10	29.932	64	57	65	49		27	29.295	48	47.5	56.5	44	.52
11	29.980	63.4	61.2	71	58		28	29.259	50.2	50	52.6	44	.04
12	30.205	57.6	55.2	76	55		29	29.853	45	44	51.2	40	1.71
13	30.316	58	54.4	65	53.6	.03	30	29.781	42	41	48.6	40.6	.24
14	30.369	54	51	59	52								Total
15	30.289	57.6	54	62	51.4		Average	29.929	53.3	51.7	63.3	47.9	4.68
16	30.271	57.6	55.4	70	48.2								
17	30.281	56	53	68	53								

October.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Reduced	Dry Bulb	Wet Bulb	Max.	Min.			Reduced	Dry Bulb	Wet Bulb	Max.	Min.	
1	29.226	50.8	50	53	42.5	.65	18	29.892	54	51.8	62.5	50	
2	29.261	48.9	47.5	55.6	47	.08	19	29.667	57	56.5	64	52	.08
3	29.342	45.5	44.5	55.2	40		20	29.790	52.2	51.2	60	51	
4	29.744	43	42.5	53	40.5		21	30.005	44	42.5	56	37.5	.21
5	29.742	48.2	46.5	61.2	40	.01	22	30.308	44.5	43	52.5	40	
6	29.802	52	50	59	47	.34	23	30.335	43.2	43.2	61	33	
7	29.614	44.8	44.2	56.5	44.2	.02	24	30.205	44	43.2	52.5	39.5	.02
8	29.924	43	41.5	55.2	36		25	30.392	39	38.8	53.5	36	
9	30.226	39	38.5	58	32		26	30.316	49.2	48	56.2	38	
10	30.456	41.8	40.5	55	33		27	30.035	52.5	51	57.5	48	
11	30.261	45	42.5	55.2	40		28	29.789	51	49	59	46	
12	30.415	41.5	40.5	54	33		29	29.555	45.5	44	53.5	42	.10
13	30.479	42	40.5	58.2	33.5		30	29.618	47	46.2	57	45	.31
14	30.294	44.8	43	56.2	39.8	.05	31	29.820	48	47	49.2	40	
15	30.084	46.2	45.5	55.2	44								Total
16	29.985	48.5	48.2	56	45	.04	Average	29.952	46.8	45.6	56.5	41.2	1.98
17	29.936	54.5	53	61.5	43	.07							

November.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Reduced	Dry Bulb	Wet Bulb	Max.	Min.			Reduced	Dry Bulb	Wet Bulb	Max.	Min.	
1	30.014	43.6	41.8	52	42.8	.01	18	30.285	25	24.5	37.2	23.2	
2	30.171	43.8	42.5	51	42.5	.04	19	30.443	28	27	39.2	19.5	
3	30.160	43.4	42.6	46	39.2	.02	20	30.362	35	33.5	41.2	27.2	
4	30.128	42	41.7	51.5	38.8		21	30.139	32.6	30.2	42	29.2	
5	30.208	38.4	35.2	48	30.8		22	30.050	31.6	31.6	35.5	29	.04
6	29.956	31	30.5	46.2	29	.02	23	30.183	30.5	31	37	29	.01
7	29.648	37.2	36.4	46	30.6		24	30.020	36.4	36.6	42.4	30.2	
8	29.477	42.8	42.8	46.4	36.8		25	29.999	32	32	41.4	30.5	.06
9	29.766	33.2	32.2	51.4	31		26	30.001	38.5	38.2	38.8	32.6	.03
10	29.660	35	33.8	45.4	32.8		27	30.079	36.2	36	41.8	34	.02
11	29.722	30	29.8	42.2	27		28	30.055	33.5	33	41.5	30.5	.05
12	30.005	29	27.8	37.2	24		29	29.956	32.6	32.4	41.2	29.5	.03
13	30.293	26.8	26.4	43	25.5		30	29.930	33	32	38.5	32.1	
14	30.218	38.5	36	40	26.5	.44							Total
15	29.778	46.2	45.8	48.2	37.8	.12	Average	30.024	37.17	34	43.5	31.1	.92
16	30.093	33	32	50.2	32.5	.03							
17	29.933	29.5	26.8	44.6	29								

December.

Date	Barom. Re-duced	Temperature				Rain	Date	Barom. Re-duced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.				Dry Bulb	Wet Bulb	Max.	Min.	
1	30.070	35.8	34.2	36	32.5		18	30.181	45.5	43.6	45.6	28.5	.01
2	30.376	31.5	30.8	40	28		19	30.037	42.5	42	49.5	41	.005
3	30.176	34.2	33.5	43.2	30.5	.025	20	29.894	39.5	39	47	34.5	.095
4	30.312	25.2	24.8	37.2	23.6		21	30.023	35.5	34	42.2	34	.29
5	30.444	23.8	23.8	34	21.2		22	30.010	41	41	42.2	35	.15
6	30.258	32	31.5	34.5	23.2		23	30.160	37.6	37.4	45.4	35	.02
7	30.249	30.4	29.2	36.5	27.5		24	30.104	44	42	44	36.4	
8	30.650	24	24	36.5	19.6	.01	25	30.008	42.6	42	47	40	.02
9	30.576	28.6	28.4	33.4	22.8		26	29.792	36	36	43.2	32	.18
10	30.470	31.4	31.5	38.5	28.2		27	29.513	42.8	41.8	46	35.2	.29
11	30.550	33.2	32	35.2	24.5		28	29.387	45.2	44	45.4	35.6	.01
12	30.588	33	33	38.8	31.6	.025	29	29.646	37.5	37	47	36.4	.05
13	30.620	41	41	42.4	32.6	.03	30	29.791	45	43.2	47	35.4	.01
14	30.489	42	41.5	45	39	.005	31	30.002	34	33	49	33	.03
15	30.504	39.2	39.2	48.8	38	.008	Average	30.185	36.3	35.6	42.3	31.6	Total 1.275
16	30.427	41.8	41.6	45	39	.012							
17	30.433	28.8	28.2	44.5	27.6								

In publishing the above results of the first series of Meteorological observations made by Members of the School, it may be as well to say one or two words on the work that has been done.

The instruments in use are all standard instruments of the highest class, by Casella, and were carefully selected for us by R. H. Scott, Esq., the Director of the Meteorological Office, himself an old Rugbeian. They comprise a mercurial barometer, wet and dry bulb thermometers, maximum and minimum thermometers, and rain gauge. The barometer is placed at the entrance to the turret staircase in the New Schools, where it is protected from the weather, and yet is sufficiently exposed to the external air. The thermometers are at present in Mr. Wilson's garden. They are enclosed in a Stevenson's case which protects them from actual sunshine, while allowing a perfectly free passage for the air. The rain gauge is also in Mr. Wilson's garden. The charts for recording the various observations are kept in a case by the side of the barometer.

The work of observing is carried on by a "Meteorological Committee," which meets a day or two before the end of each month. Any one desirous of assisting in the observations is invited to attend, and the various instruments are then assigned, as far as possible, in accordance with the particular wish of each volunteer.

Frequently one observer takes an instrument for the first half of the month, and another for the second. It is best in all cases for two boys to become responsible for each class of observations, in case of illness, &c. The observations are taken at 8.30 A.M., as nearly as possible, each morning. The readings of the barometer and attached thermometer are entered at once in the chart, and the line drawn to shew the daily fluctuations. The readings of the thermometers and rain gauge are also taken at 8.30, and then entered in the chart sometime during the course of the day, lines being drawn in each case to shew the fluctuations.

At the end of the month the uncorrected reading of the barometer for each day is "reduced," that is, corrected for temperature and height above mean sea level, and the result entered in its proper column.

All the observations of the month, including general notices of the weather, direction and force of the wind, amount of cloud, &c., together with the totals and averages for the month, are then copied into a printed Form supplied by the Meteorological Office, and sent to Mr. Scott, the Director.

Many members of the Committee have shewn real zeal and interest in taking the observations for a lengthened period, and in some cases where the observers were associates of the Natural History Society, they have been admitted to the privileges of full membership as a reward for their labours.

The work is really an important one, as no complete series of Meteorological observations had been previously attempted in this locality. It is also in itself good practice in easy instrumental manipulation, the only requisites being care, accuracy and truthfulness.

T. N. HUTCHINSON.

The names of the observers during the past year are given below; all except three are either members or associates.

J. Armitage
C. D. Baynes
J. O. Beuttler
E. Burchardt
W. H. Cornish
C. P. Eden
F. A. Frost
C. H. Hinton
H. N. Hutchinson
O. Leggatt
W. B. Lowe
A. Macgregor
F. A. B. Miller
A. W. Moore
A. S. Napier
D. A. Ogilvie
F. R. Over
W. B. Wise
E. T. Wise
A. M. Worthington

On Sun Spots.

I observed and measured a fine sun spot on May 6th, 7th, and 8th, (1871), drawings of which are shewn in Plate IV.

The "bridges" were remarkable for their great beauty, and for the rapidity with which they altered their form.

In the principal spot when observed on May 6th, at 7.30 A.M., there were three large bridges, the upper and lower extending entirely across the dark umbra, the central one being connected with the penumbra at one end only. By 2.30 in the afternoon the lower bridge had broken down, leaving only the abutments to shew where it had been. A small bridge had also sprung into existence connecting the upper and central bridges.

On the next day, at 11.30 A.M., the upper bridge had broken away from one side of the penumbra and presented an exquisite appearance—a lance of brilliant silver terminating in a needle-like point. The abutments of the lower bridge had by this time almost entirely vanished.

On the following morning, at 7.30 A.M., the spot had greatly changed its appearance.

A curious tail-shaped penumbral portion had been thrown out on one side containing quite a net work of small dark spaces: the upper bridge had disappeared, and the central one that had previously been connected with the penumbra on one side only, was now joined to it at each end.

The upper and lower drawings in Plate IV. shew the entire group, the two others giving only the principal spot on a somewhat larger scale.

The dimensions on May 6th at 7.30 A.M. are given below.

Entire width of group of spots, 144,077 miles.

Penumbra of chief spot, 46,816 miles by 33,689 miles.

Large umbra, 19,085 miles by 18,234 miles.

Definition was singularly perfect during the observations, and the detail was seen in my Reflector with great clearness.

T. N. HUTCHINSON.

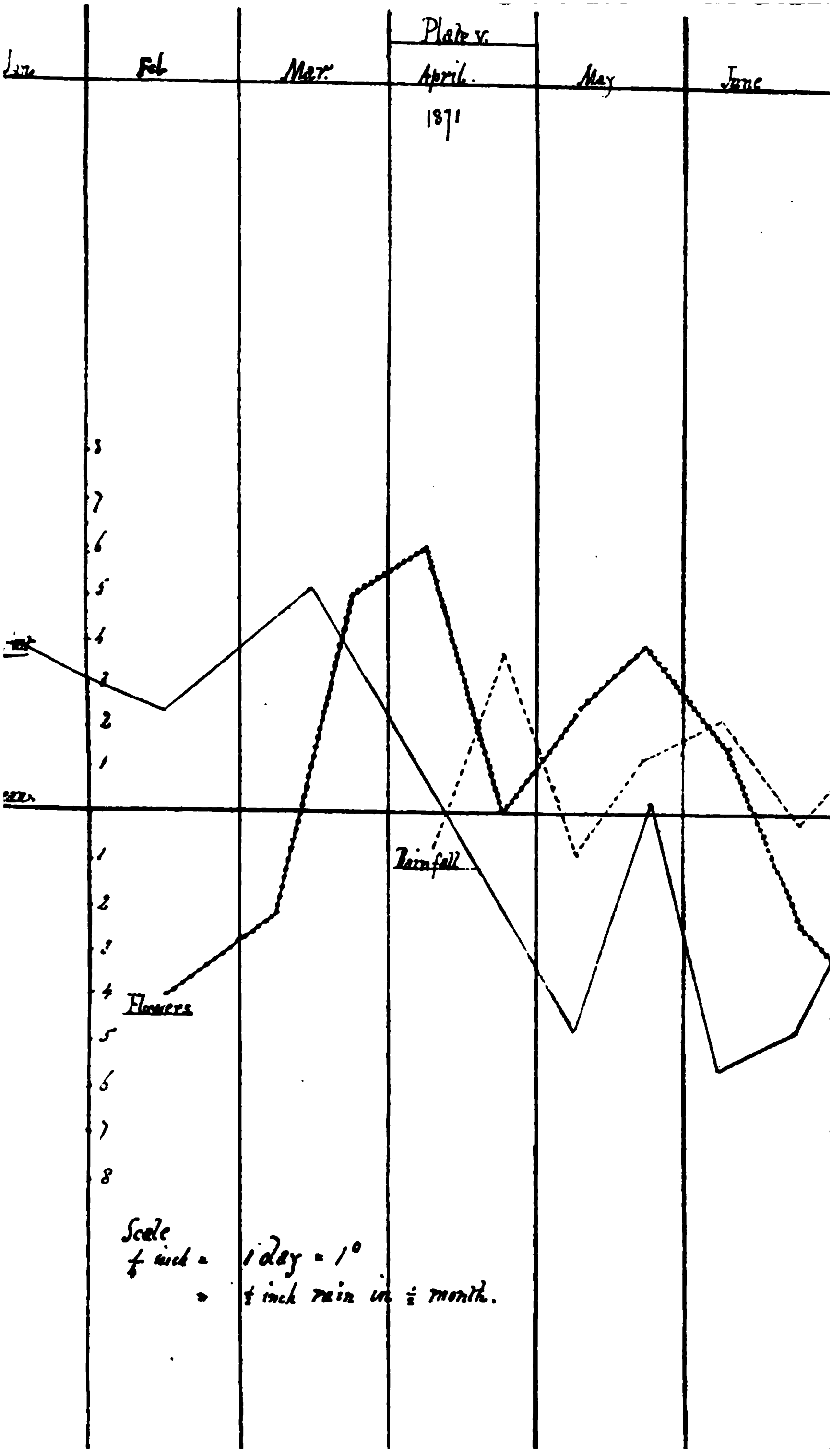
On Rainfall, Temperature, and Dates of Flowering.

In Plate V. will be seen a table exhibiting in the manner described on p. 7 of the Report for 1870, the backwardness or forwardness of the year 1871. The straight line indicates by its rise or fall that the heat was above or below the average; the intermittent line marks by its rise or fall that the fall of rain was above or below the average; the dotted line indicates when it rises that the flowers of that part of the year came before their time, and when it falls, that the flowers of that part of the year were later than usual. Owing to the fact that the school rain-gauge was not in work before April, the rain line does not begin till that month.

The following is the table of the year:—

	Average heat at 8.30 a.m.	Total rainfall in inches.	Dates of Flowering.	Excess of heat or deficit.	Excess of rain or deficit per ½ month.
Jan. 1—15	31.75			+ 3.8	
16—31	33				
Feb. 1—15	41		4 days late (8 obs.)	+ 2.2	
16—28	41.25				
March 1—15	41.50		2 days late (13 obs.)	+5.1	
16—31	42.66		5 days early (12 obs.)		

Plate v.



Scale
¼ inch = 1 day = 1°
= ¼ inch rain in ½ month.

		Average heat at 8.30 a.m.	Total rainfall in inches.	Dates of Flowering.	Excess of heat or deficit.	Excess of rain or deficit per ½ month.
April	1—15	45	.18	6 days early (15 obs.)		— .36
	16—30	49.75	2.44	average date (34 obs.)		+ 1.90
May	1—15	45.30	.05	2½ days early (45 obs.)	— 4.7	— .32
	16—31	54.33	1.45	4 days early (55 obs.)	+ .2	+ .58
June	1—15	51.5	2.22	1½ days early (39 obs.)	— 5.4	+ .98
	16—30	54.1	.94	2½ days late (34 obs.)	— 4.7	— .08
July	1—15	58.7	2.08	4 days late (24 obs.)	— 1.6	+ .93
	16—31	58.9	2.09	3 days late (12 obs.)	— 3.1	+ .99

These observations are illustrated in Plate v, in which the scale is the same as last year, viz., ¼in. for 1 day late or early, ¼in. for 1 degree more or less of average heat, ½in. for 1 inch of rain above or below the average in the total of half a month.

It has been suggested that we should get a more correct result by taking only the dates of some 50 carefully watched flowers. I believe the result would be much the same as given above. For instance, I have calculated the backwardness and forwardness of this year by the dates of 50 very common plants, selected by H. G. Wauton, and I find that in no case is there much variation from the results given by taking in the dates of all the plants observed, and in three months the results are identical. This is very encouraging, as proving that our results are consistent and trustworthy.

F. E. KITCHENER.

Botanical Section.

We have recorded this year notices of upwards of 350 plants, a rather smaller proportion of our list than last year, but quite up to the average. Some of these, however, are not, I fear, quite so accurate as they might be, owing to the fact of their having been left almost exclusively to a few hands, and lacking the certainty produced by a comparison of dates.

There are more notices of good plants this year than usual, but on the other hand the pond-weeds, sedges, and grasses, appear to have come in for very small notice, much less than they deserve.

Though one might reasonably suppose that our Flora had by this time been perfectly worked out and exhausted, I have yet to record as many as 10 *new plants*,—of which two only are doubtfully indigenous—8 *plants recovered*, *i.e.*, which have hitherto existed only on the list and have not been recorded for a great many years, if at all, 4 *to be removed from brackets* as being now found within the required distance of 4 miles.

These are,

New Plants.

Lithospermum officinale.

Veronica triphyllos—a plant of a local eastern county type, found as a corn-field weed.

Brassica alba—common in turnip fields about Bilton, probably imported with the seed.

(*Stachys arvensis*)—Brandon, but might, I think, be found nearer home.

(*Carex vesicaria*)—found several years ago at Frankton Wood, and identified in looking over my collection.

Salix cinerea.

Pedicularis palustris—
Scripus multicaulis—
Carex distans—
Trifolium filiforme—
found by Rev. A. Bloxam near Harboro', and reported to the President.

Plants Recovered.

Cardamine impatiens—growing on a rockery in my own garden, probably introduced with soil: I can guarantee its not having been planted there. On moist rocks and shady places is the *habitat* Bentham gives for it, which this was.

Pimpinella magna—recorded by Mr. Bloxam, but not hitherto corroborated by any of ourselves.

Chenopodium polyspermum.

Bidens cernua.

Salix phyllicifolia.

Triglochin palustre.

Juncus compressus—found before by H. C. L. Reader at the coal wharf, re-discovered by myself this year in 2 distinct places.

Echium vulgare— lost since 1867. Found this year at Cawston—an old *habitat*—by myself, and at Hillmorton by E. Wise.

Plants to be Removed from Brackets.

Ophioglossum vulgatum—formerly found beyond Cotesbach, now found in meadows by "Rain's Brook," near Barby, by F. R. Hodgson.

Trifolium striatum.

Carex pseudo-cyperus.

Trifolium arvense—a fugitive plant and growing in solitary specimens. I have found it in 2 distinct localities this year.

Lastly, we have a very complete list of plants out on Nov. 1, Dec. 1, and Christmas Day, an extremely useful work and one barely attempted before. By this we find that there were no less than 95, or about ⅛ of our whole flora alive and flowering on Nov. 1, or a few days later. These include some which you would scarcely expect to find so late, such as the Cowslip, the Wild Strawberry, and the Germander Speedwell. Of this list we only find 16 surviving on Dec. 1, a smaller number than one might otherwise have expected, owing to the extreme frosts in the middle of Nov., and of these 16, I noticed 12 out on Christmas Day, or after, some of which, such as Lycopsis arvensis, cannot be considered as "all the year round" plants, but rather as dying very hard. It is only fair to state that the Christmas Day specimen of the Cowslip was one on my own rockery, transplanted from its wild state in the spring. I might also add the Primrose, which was out under similar conditions by Jan. 7.

If we could always get a list like this of late flowerers, we should have a very good index of the hardihood of our plants, with their duration of flowering.

List of Late-flowering Plants.

Ranunculus acris
————repens
Papaver dubium
————Rhœas
Fumaria officinalis
Capsella Bursa-pastoris, till Jan. 7
Sisymbrium officinale
Brassica Campestris
————sinapistrum, 0
————alba
Raphanus Raphanistrum, 0
Sinapis arvensis
Viola arvensis
Silene noctiflora, Nov. 7
Lychnis diurna
————Vespertina, Nov. 7
Sagina procumbens
Spergula arvensis
Stellaria media, Jan. 7
————graminea, till Jan. 7
————uliginosa
Cerastium aquaticum, Nov. 9
Malva sylvestris, Nov. 7
————rotundifolia
Geranium molle, Dec. 25
————dissectum
————Robertianum
Ulex europæus, Dec. 25
Medicago lupulina
Trifolium arvense
Trifolium pratense
————minus
Vicia sepium
Geum urbanum, Nov. 7
Potentilla reptans
Fragaria vesca
Rubus cæsius
————fruticosus
Alchemilla vulgaris
Sanguisorba officinalis, Nov. 9
Epilobium parviflorum
————montanum
————palustre, Nov. 9
Hedera Helix, Dec. 5
Pimpinella Saxifraga
Æthusa Cynapium
Heliosciadium nodiflorum
Heracleum sphondylium
Daucus Carota
Anthriscus sylvestris
Lonicera Periclymenum, Nov. 9
Sherardia arvensis
Galium Aparine
Scabiosa succisa
Hypochœris radicata
Sonchus arvensis
————asper
————oleraceus
Crepis virens
Hieracium umbellatum, Nov. 20

Hieracium Pilosella
Taraxacum officinale
Lapsana communis
Carduus crispus
————lanceolatus
————arvensis
————nutans
Centaurea nigra
Leontodon autumnalis
Mentha aquatica, 0
Scutellaria galoriculata, 0
Thymus Serpyllum, 0
Gnaphalium uliginosum
Filago germanica
Senecio vulgaris, Dec. 25
————aquaticus
Helminthia echioides
Bellis perennis
Chrysanthemum Parthenium
————inodorum, Dec. 5
————Chamomilla, Dec. 25
————Leucanthemum, Oct. 1
Achillea Millefolium, Dec. 5
Campanula rotundifolia
Veronica serpyllifolia, till Jan. 7
————Chamædrys
————hederæfolia
Veronica agrestis, Dec. 25
————Buxbaumii
Linaria elatine
————vulgaris
Ballota nigra
Lamium album, Dec. 25
————purpureum
Galeopsis Tetrahit
Stachys sylvatica
Prunella vulgaris
Myosotis arvensis
————palustris, Oct. 1
Scrophularia nodosa, Oct. 1
Lycopus Europæus, Oct. 1
Lycopsis arvensis, till Jan. 7
Primula veris, Nov. 1, and Dec. 25
Anagallis arvensis
Plantago lanceolata, Dec. 5
Atriplex patula
Polygonum aviculare, Nov. 9
Euphorbia Helioscopia
————exigua
————Peplus
Urtica urens
Poa annua
Lolium perenne, 0
Dactylis glomerata, 0

NOTE. Those without any date attached to them were out on November 1 only; the plants marked 0 are reported by J. Armitage as out on the 1st of October.

And now a few words about the facts gleaned from these observations of plants and the use they may be put to. I do not want to say much about the backwardness or forwardness of last year's seasons, because I hope we shall be favoured with a chart of all that, side by side with a chart of the rainfall and temperature, as we have been hitherto. I would only remark upon the extreme lateness of almost all our summer and autumn plants, showing distinctly that no amount of rain alone without heat and sunshine is sufficient to bring the plants on.

It is curious to observe that of all these, the Composites and Umbellifers are most especially backward; I have calculated by rough estimates, but as near as I could get, that the summer-flowering species are respectively 11 and 8 days backward as compared with 5 days in the Scrophularia and Rose families, and 8 days *before* the mean in the Œnothera family, that is to say, among the Epilobes. I can only account for it by their being more compound and intricate in structure, the former of flower, the latter of stalk, and therefore requiring sun to a greater

RADCLIFFE.

degree: the common Spear-leaved Thistle (carduus lanceolatus), which could not well be overlooked, and which I specially looked out for, is more than a month behind the average; and this for three reasons I think: (1) because it has a tall stem to rear, (2) an extremely hard head, (3) a very large and compound flower.

For the same reason all the other Thistles, except the Marsh and Dwarf Thistle, the one having a smaller and softer head, the other no stem to trouble itself about, are also far behind time. Other plants again may be accounted for by their increased luxuriance of leaf, which always greatly retards or takes away from the flower. Of this class I noticed especially the Common Enchanter's Nightshade, the Hedge Convolvulus, and the Water Starwort (Cerastium aquaticum); which last, instead of contenting itself with 1 or 1½ feet of height, has this year become a veritable climbing plant, creeping some 6 or 7 feet up the hedge, and being consequently a month or more behind its time. The Common Convolvulus (C. sepium), the flower of which requires a good deal of sun to bring it out, scarcely flowered at all; I hardly noticed a single flower. These few plants, all of which I studied carefully, seem to me very good instances of the way in which a wet and backward season acts upon plants.

Lastly, with regard to the practical uses of these yearly notices. I have already pointed out the usefulness of getting a list of late flowerers as we have this year, and which I hope will be continued. There is more certainty in such lists than in the early notices of plants, which often vary by a month or more according to the sharpness of the observer. It is very useful however to have all notices of plants, more especially the rare ones, if it be only to show that the plant is still in existence. On the other hand, we ought to be particularly on the look-out for the very earliest arrival of those plants which are especially characteristic of their month or season. All the first spring plants should be marked with the greatest care: next the date of the Blackthorn, the Hawthorn, Hyacinth, Rose, and Honeysuckle: then of the later summer flowers, the St. John's-worts and the Thistles, the Ragworts: and last of all, quite in the autumn, the Ivy. These are the most satisfactory plants to mark the seasons by, and they are within the reach of all, even those who know nothing of Botany. Without care and accuracy these reports may be after all very deceptive. I notice, for instance, this year a difference of a whole month or more in the dates noted down by different collectors of such common plants as the Helmet Orchis (O. morio) and Venus'Comb (Scandix pecten). Again, one of the commonest of our Umbellifers, (Heracleum sphondylium), appears by the report to vary in its time of flowering by nearly 3 months in different years, that is to say, according to the sharpness of different observers. I fancy, too, in looking over the lists of preceding years, that several plants, such as the Snowdrop, Violet, Honeysuckle, &c. have been observed only from garden specimens, which are almost always a fortnight in advance of their less fortunate neighbours. Lastly, the notices of ferns—when noticed at all, which is not often—differ so very widely that I suspect the young fronds have been noted down as appearing long before they had really unfolded themselves, and when only just above ground.

What we really want, to obtain more accurate dates, is a greater number of rival notices from different quarters. If a few more members who care anything about Botany would take the trouble to note down carefully and accurately the plants they observe merely in their Sunday walks, they would be conferring a real benefit on the Society, and still more on themselves, by discovering the difference between eyes and no eyes.

Those who have contributed dates to the floral calendar of this year are the President, H. G. Wauton, J. Armitage, R. Barlow, H. Deane, E. T. Wise, and a few others, and the list has also been compared with one kept independently by Mrs. Kitchener.

Our thanks are due to the Rev. A. Bloxam for corrections, and additions to the list printed last year.

H. G. Wauton.

Geological Section.

Localities new to the list, not recorded in Geological Album:

Ammonites angulatus	Toft Clay Pits.
Pleurotomaria Anglica	„
Vertebra	(8 miles from Rugby), Stockton Lime Works.
Ammonites planorbis	(6 miles from Rugby), Lime Works, Stretton-on-Dunsmore.

W. B. Lowe.

The following is a list of fossils which have been presented to the Society during 1871.

Fossils sent by W. H. Dutton, Esq., of Newcastle-under-Lyne, from the Staffordshire Coal-measures.

Trigonocarpus oblongus, in sandstone.
Anthracosia robusta, 4 specimens.
Walchia (? formation).
Sphenopteris latifolia (Brong.), Silverdale.
Neuropteris gigantea (Brong.), terminal portion, Silverdale.
Lepidodendron.
Pecopteris urophylla.
Pecopteris affinis.
Neuropteris heterophylla.
Sphenopteris affinis, Audley, Staffordshire.
Alethopteris lonchitica (Brong.).

Neuropteris gigantea.
Asterophyllites equisetiformis.
Neuropteris microphylla.
Diplodus gibbosus (tooth of), Ag.
Megalichthys Hibberti Ag. teeth of, scales.
Fish remains—scales.
Helodus simplex (Ag).
Acanthoides Wardi.
Lepidodendron elegans.

Fossils presented by the Marlborough College N.H.S., through Rev. T. A. Preston.

From the Middle Devonian ;
Osteolepis macrolepidotus.
Diplacanthus perarmatus.
Osteolepis microlepidotus, 2 spec.
Coccosteus decipiens.
Cheiracanthus pulverulentus.
Cheirolepis Trablii.
Pterichthys cancriformis.
Diplopteris Agassizii.

W. B. Lowe.

Zoological Section.

March 6th.	Three Snipes, near Hillmorton.	J. Armitage.
March 28th.	Rook's pellets, at Chapel Wood, consisting entirely of vegetable matter.	J. Armitage.
May 10th.	Corncrakes heard near Lawford Road.	C. M. Chadwick.
May 15th.	Sandpiper, seen near Reservoir.	D. A. Ogilvie.
May 20th.	Cuckoo's egg in Reed-Warbler's nest.	W. Pringle.

Dates of Eggs seen.

March 6th.	Blackbird.	J. Armitage.
March 23rd.	Rook.	A. S. Napier.
March 24th.	Thrush.	J. Armitage.
March 28th.	Robin, (set).	B. R. Wise.
April 9th.	Missel Thrush.	
April 29th.	Coot, Moorhen, Jackdaw, Jay, Starling.	
May 6th.	Garden-Warbler, Wild Duck, Bullfinch, and Lesser Whitethroat.	C. M. Chadwick.
May 10th.	Chaffinch, Brown Linnet, Greenfinch.	A. G. Burchardt.
May 13th.	Chaffinch with young.	A. S. Napier.

May 14th. Partridge. F. R. Hodgson.
May 15th. Black-headed Bunting. F. R. Hodgson.
May 20th. House-Sparrow, Blackcap, Whitethroat, Tree-sparrow, Willow-Wren. C. M. Chadwick.

J. G. Adamson.

Entomological Section.

Additions to the List of Local Specimens, in 1871.

Hepialus hectus*	AS	Anticlea badiata	AS
Calligenia miniata	AS	Cidaria populata	AS
Selenia lunaria	AS	Cilix spinula	JA
Selenia illustraria*	AS	Xylophasia lithoxylea*	AS
Odontopera bidentata*	AS	Orthosia lota	HAB
Ennomos angularia	AS	Calocampa exoleta	AFB
Thera firmata	AFB	Plusia chrysitis	AS
Melanthia albicillata	AS	Catocala nupta	HAB

Those marked * are confirmations of species previously doubtful.

A collection of Specimen Beetles has been presented by A. Sidgwick and W. C. Marshall.

List of Species bred from dug Chrysalides.

Phigalia pilosaria
Taeniocampa stabilis
Taeniocampa instabilis
Taeniocampa cruda
Hibernia progemmaria
Rumia crataegaria
Selene lunaria
Selene illustraria
Amphidasys betularia

Early Appearances.

Anisopteryx aescularia, 19th March
Amphidasys prodromaria, 20th March
Anticlea badiata, 20th March
Chimabacche fagella, 7th April
Incurvaria masculella, 6th May
Adela schwarziella, 15th May

This list is absurdly short, owing to the paucity of observers.

It is to be hoped that this year the large Entomological section may make a great improvement.

A. Sidgwick.
A. F. Buxton.

CATALOGUE
OF
LOCAL FOSSILS IN THE MUSEUM.

SAURIAN REMAINS.

Specimen.	Locality.	Observer.
6 large vertebræ of Icthyosaurus	Newbold	W
1 vertebra, ? Plesiosaurus	Newbold	J Lawe
1 vertebra, Icthyosaurus	Newbold	Mahony
Rib of Icthyosaurus	Victoria Works	W
Rib from the avicula papyria zone	Victoria	W
4 vertebræ	New Bilton Clay	W
1 vertebra	Rugby	W
1 saurian bone	Rugby	W
1 saurian tooth	Newbold	O Leggatt
1 vertebra	Hillmorton	J M Lester
2 vertebræ	Unknown	
1 sham vertebra, made by workmen	Newbold	W
Coprolites	Hillmorton & Victoria	

FISH REMAINS.

Hybodus reticulatus, Dorsal spine	Newbold	Clough
Æchmodus, 3 specimens	Victoria	
Pholidophorus ? portion of fin	Victoria	D Ogilvie
Fish scales in shale	Victoria	

CRUSTACEAN.

Portion of crustacean	Rugby	O Leggatt

MOLLUSCA.

CLASS I. CEPHALOPODA.

Order 1. Dibranchiata.

Belemnites elongatus	Newbold & Hillmorton	
Belemnites acutus	Hillmorton	W
Belemnites obtusus ?	Hillmorton	O Leggatt
Phragmocones and alveoli of belemnites		

Order 2. Tetrabranchiata.

Family 1. Nautilidæ.

Nautilus striatus	Hillmorton	G H Lloyd
	Rugby	W & O Leggatt
	Hillmorton	C Arnold
	New Bilton	W
Nautilus lineatus	New Bilton	W
Casts of Nautilus, crystallized	Victoria	W

Family 3. Ammonitidæ.

Specimen.	Locality.	Observer.
Ammonites ? angulatus, (large)	base of Victoria Works, 1871	W
Ammonites { angulatus (JK) Ammonites { oxynotus (RE)	base of Victoria Works, 1871	W
Ammonites angulatus	New Bilton	W
Ammonites angulatus ?	Newbold	O Leggatt
Ammonites angulatus	Bilton Road	J Lawe
Ammonites angulatus	Hillmorton	Venables
Ammonites angulatus	Hillmorton	E Prevost
Ammonites Bucklandi	Rugby Pits	E Prevost
Ammonites Bucklandi (var.)	New Bilton	W
Ammonites Bucklandi	Rugby	E Cleminshaw
Ammonites Bucklandi	Newbold	E Cleminshaw
Ammonites Bucklandi, 2 spec.	locality unknown	
Ammonites Brookii	Kilsby	E Cleminshaw
Ammonites Brookii	New Bilton	W
Ammonites armatus	New Bilton	W
Ammonites armatus, 2 spec.	Rugby	L F Pirie
Ammonites armatus, 3 spec.	Hillmorton	W
Ammonites armatus densinodus, 3 spec.	Hillmorton	L F Pirie & W
Ammonites Birchii, 6 spec.	Hillmorton	O Leggatt & W
Ammonites catenatus	Newbold	W
Ammonites catenatus	Hillmorton	L F Pirie
Ammonites catenatus	Rugby	W
Ammonites communis raricostatus	Hillmorton	
Ammonites Conybeari	Victoria	W
Ammonites Conybeari	New Bilton	W
Ammonites cornucopia	Kilsby	E Cleminshaw
Ammonites Dudresii, 2 spec.	Rugby	W
Ammonites Dudresii	New Bilton	W
Ammonites forficatus, 4 spec.	Hillmorton	O Leggatt & W
Ammonites Guibalianus, 2 spec.	Hillmorton	O Leggatt
Ammonites ? elegans, and var.	Hillmorton	W
Ammonites Henleyi	Hillmorton	
Ammonites obliquistriatus	Newbold	W
Ammonites obtusus, (? RE)	New Bilton	W
Ammonites ophioides, 5 spec.	Hillmorton	W
Ammonites planorbis	Newnham Regis	E Cleminshaw
Ammonites planicostatus	New Bilton	W
Ammonites oxynotus	Hillmorton	O Leggatt & L F Pirie
Ammonites oxynotus	Victoria	W
Ammonites semicostatus, 5 spec.	Hillmorton	L F Pirie
Ammonites semicostatus	Newbold	W
Ammonites semicostatus	New Bilton	Mawdsley
Ammonites semicostatus	Low Morton	W
Ammonites Turneri	Hillmorton	
Ammonites communis ?	Hillmorton	L F Pirie
Ammonites halecis	Rugby	W
Ammonites rotiformis ?	Hillmorton	W
Ammonites ziphus	Hillmorton	
Ammonites amaltheus ?	Hillmorton	L F Pirie
Ammonites sauzeanus	Rugby	O Leggatt
Ammonites heterophyllus ?	Hillmorton	W
Ammonites, Nacreous impression of shell		L F Pirie

CLASS II. GASTEROPODA.

Specimen.	Locality.	Observer.
Pleurotomaria similis	Hillmorton	W
Pleurotomaria anglica, 5 spec.	Hillmorton	
Pleurotomaria, casts of do., 5 spec.	Hillmorton	
Pleurotomaria depressa	Hillmorton	
Pleurotomaria, young do.	Hillmorton	
Rotella lobelliformis	Hillmorton	H S Jeffery
Turritella	Newbold	E Cleminshaw
Turritella	Hillmorton	O Leggatt
Turritella	Rugby	W
Unknown	Rugby	R F Boyd
Dentalium	Hillmorton	
Actæonina fragilis	Rugby	A C Bruce
Trochus		
Cerithium	Hillmorton	A C Bruce

CLASS IV. BRACHIOPODA.

Discina Holdeni, 9 spec., and casts	Newbold	E Cleminshaw
Rhynconella ? variabilis, 2 spec.	Hillmorton	E Cleminshaw
Rhynconella, group of, in limestone	Victoria Works	W
Rhynconella do., in shale	Victoria Works	W

CLASS V. CONCHIFERA.

Lima gigantea, series of, 15 spec.	Rugby & Newbold	W
Lima pectinoides	Hillmorton	
Lima rigida	New Bilton	O Leggatt
Gryphœa incurva, series	New Bilton	
Gryphœa cymbium		
Ostrea arietis		
Ostrea liassica	Newnham	E Cleminshaw
Slab of Gryphœa, Pecten, &c.	Rugby	W
Plicatula spinosa	Hillmorton	W
Plicatula ?	Victoria	
Modiola scalprum	Kilsby	Venables
Modiola Hillana, 2 spec.		
Modiola cuneata	Hillmorton	L F Pirie
Modiola minima, group of	Rugby	W
Pinna diluviana	Hillmorton	C S Taylor & E Cleminshaw
Pinna diluviana	Hillmorton	O Leggatt
Pholadomya gibbosa, 2 spec.	Hillmorton	W
Pholadomya ambigua	Hillmorton	W
Pholadomya ambigua	Lias Marlstone	
Hippopodium ponderosum, 2 spec.	Hillmorton	W
Leda rostralis Leda complanata	Hillmorton	L F Pirie
Cardinia Listeri	Hillmorton	L F Pirie
Cardinia ovalis	Hillmorton	L F Pirie
Astarte	Hillmorton	
Goniomya rhombifera	Hillmorton	J Armitage
Avicula decussata	Newnham	E Cleminshaw
Avicula papyria, several spec.	Victoria	W
Avicula sinemuriensis	New Bilton	E Cleminshaw
Arca truncata, 2 spec.	Rugby & Hillmorton	E Cleminshaw

Specimen.	Locality.	Observer.
Myacites	Newnham	E Cleminshaw
Panopœa elongata	Newnham	E Cleminshaw
Pecten æquivalvis	New Bilton	W
Pecten æquivalvis	Hillmorton	W
Pecten textorius	Hillmorton	O Leggatt
Pecten, group of	Hillmorton	O Leggatt
Pecten	Newnham	
Unicardium cardioides, 3 spec.	Hillmorton & Rugby	

RADIATA.

CRINOIDEA.

Pentacrinites Briareus	Rugby, New Bilton, Hillmorton, Newbold	
Pentacrinites robustus	Newbold	
Pentacrinites ? basaltiformis	Rugby	
Spines of cidaris	Newbold, Rugby, Hillmorton	

CORALS.

Montlivaltia rugosa	Hillmorton	W & O Leggatt

MISCELLANEOUS SPECIMENS.

Fucoids from Victoria limestone	W
Fossil wood and imperfect jet from Hillmorton	W
? Fucoidal limestone, Newnham	W
Slickenside from side of fault at Newbold	E Cleminshaw
Septaria, Nodules, Ironstone, &c.	
Specimens of white lias from Newnham, shale from Victoria, &c.	

SPECIMENS TO ILLUSTRATE THE SURFACE FORMATIONS.

(1) A collection of bones from the alluvial deposits of Lawford, unnamed.	E Cleminshaw & others
(2) A collection of striated stones from the boulder—middle glacial ?—sands and clays of Rugby, Newbold, Brownsover, Clifton, Brinklow, Leir, &c.	JBA, CST, & W
(3) A collection of stones from the northern drift.	W
(4) Specimens of the oolitic deposit of Brownsover.	W

JK .. J. Kershaw, Warwick.
RE .. R. Etheridge, F.R.S.
JBA .. J. B. Alexander, India.
CST .. C. S. Taylor, Oxford.
W .. J. M. Wilson, Rugby.

J. M. W.

W. BILLINGTON, PRINTER, RUGBY.

RUGBY SCHOOL
NATURAL HISTORY SOCIETY.

1872.

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

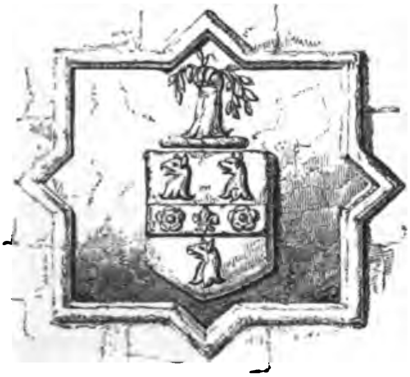
REPORT

OF

THE RUGBY SCHOOL
NATURAL HISTORY SOCIETY

FOR THE YEAR

1872.



"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1873.

PREFACE.

Our sixth Report is too crowded to need a long preface. We hope our pages will shew those interested in our Society that we are still alive, and in some respects very much so. Still there are many of our Associates who are content with being ornamental rather than useful adjuncts to our Society; the number of real workers is very small compared with the number of names on our list, and some of the Sections are deserted or inactive. Every Associate should remember that he is in duty bound to be a worker at some one of the many subjects attempted by our Society, and as a primary step should become a working Member of one of the Sections.

With a view to stimulating work among the younger Associates, the number of Members is henceforward to be limited to 15, so as to make the election to membership a real distinction.

The success of the original founders of this Society at Oxford should encourage the present Members to make their mark, in promoting the well-being of our Society, as Longstaff and Cleminshaw did six years ago.

It is something for a School Natural History Society to have had an Oxford First Class List almost entirely filled up by its old Members.

One real working Member of our body has been taken from us this year: for the first time a name has been suddenly struck off our list by death. It is not meet that we should close this preface without a thought of affectionate regret to the memory of D. A. Ogilvie.

F. E. Kitchener, President.
L. Maxwell, } Editors.
H. O. Arnold, }

Society's Room,
Easter, 1873.

NATURAL HISTORY SOCIETY'S ACCOUNTS FOR 1872.

Receipts.				£.	s.	D.
By balance - - - - -				11	18	1
Compositions - - - - -				13	10	0
Subscriptions, Lent Term,	£2	7	6			
Ditto, Trinity Term,	3	10	0	8	15	0
Ditto, Advent Term,	2	17	6			
Subscriptions to Egg Cabinet - -				0	4	6
Entrance Fee of Hon. Member (Mr. Spurling)				0	10	0
				£34	17	7

Expenses.	£.	s.	D.
Egg Cabinet - - - - -	6	0	0
Wright's bill (Cabinet for Skulls) -	3	9	6
Books - - - -	4	13	7
Prizes - - - -	3	0	0
Reports distributed to the Society -	3	6	0
Cost of Anastatic Drawings - -	2	8	0
Bottles and Spirits of Wine - -	0	19	8
Printing List of Fossils, &c. - -	1	5	9
Newspapers - - - - -	0	11	10
Binding Books - - -	0	7	11
Cost of chairs for Mr. Smith's Lecture -	0	9	3
Postage - - - -	0	1	0
	£26	12	6
To Balance in President's hands - -	8	5	1
	£34	17	7

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion.

---

* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

LIST OF THE SOCIETY, LENT TERM, 1873.

Officers:

President: Mr. F. E. Kitchener, F.L.S.
Secretary: F. B. A. Miller
Curator: L. Maxwell
Editors: The President, L. Maxwell, H. O. Arnold
Album Keepers: Botanical, E. T. Wise
" " Geological, W. B. Lowe
" " Entomological, A. F. Buxton
" " Zoological, J. G. Adamson, C. M. Chadwick
Entomological Curator: Mr. A. Sidgwick

Honorary Members:

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. J. E. Smith
Rev. C. Elsee
Rev. C. E. Moberly
Mr. C. Dukes, B. Sc.
Mr. F. Spurling
Mr. Percy Smith

Corresponding Members:

Lord Bishop of Exeter
G. F. Helm, M.D.
E. P. Knubley, 68
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H. M. Geological Survey, 67
C. L. Rothera, B. Sc. 68
C F. W. Fison, F.~~G~~C.S. 67
C. S. Taylor, 67
E. Cleminshaw
C G. B. Longstaff, F.~~G~~C.S. 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
F. R. Smith
E. W. Prevost, D. Ph., F.C.S.
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S., 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H. M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
C. Hinton
E. Burchardt
A. S. Napier
R. H. Ker
A. G. Burchardt

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year. We have omitted from this list the names of those who left the School before the passing of Rule xiii, and have never since leaving made any communication to the Society. Any of these, who wish to have their names replaced on the list should communicate with the President.

Members :

W. B. Lowe
C. G. Steel
E. T. Wise
B. R. Wise
F. B. A. Miller
A. F. Buxton
J. G. Adamson
H. O. Arnold
A. B. Pearson
C. M. Chadwick
H. N. Hutchinson
D. C. Baynes
L. Maxwell
H. A. Bull
F. W. Dutton
H. Vicars
G. L. King
C. E. West
H. W. Trott

Associates :

W. H. Cornish
L. Jeffery
H. W. Scholfield
W. H. Cross
W. S. Higgin
S. Bolton
F. Swanzy
J. W. Johnson
W. A. Sparrow
J. Y. Bostock
H. B. Hemming
W. H. Prichard
T. B. Eden
C. A. Ludlam
F. D. Atkinson
A. J. Solly
H. M. Philby
J. R. Hutchinson
T. F. Johnson
A. D. Cassavetti
A. A. T. Attree
L. Parry
W. C. Berkley
J. O. Beuttler
J. D. Harris
A. Henderson
F. A. Frost
W. W. K. Clarke
G. J. Foster
C. H. Sargant
J. N. Stolterfoht
L. Knowles
A. Duff
J. Hume
S. Crosse
G. De S. Hamilton
A. Pearson
J. H. Kingdon
A. Ward
H. F. Newall
M. V. Hilton
W. J. Napier
A. W. L. Boyd
G. H. Chilcott
H. Eskrigge
R. Cunliffe
L. McMahon
V. H. Veley
E. Inglis
R. A. Hamilton
S. King
J. Turner
W. S. Benyon-Winsor
W. Abraham
G. A. Solly
R. R. Page Henderson
C. Hutchinson
C. A. James
R. A. Fayrer
H. Hurrell
R. H. B. Bolton
R. D. Oldham

LIST OF PAPERS.

PAGE.
On the Earliness of the Season, by B. R. Wise* - - - - 1
On Protective Mimicry in Spiders, communicated by the Rev. C. W. Penny - - - - - - - - 7
On the Work of an Anatomical Section, by A. G. Burchardt* - 10
A Visit to Norway, by E. T. Taylor* - - - - - 14
On Spectrum Analysis, by L. Maxwell* - - - - 19
On Motive Power, and Ammonia and Carbonic Acid as Motive Power for Engines, by H. N. Hutchinson* - - 28
On the New Organ for the School Chapel, by Rev. C. J. E. Smith 31

Astronomical Report, by Mr. Wilson - - - - 34
Observations on the Meteors, by L. Maxwell - - - 37
Meteorological Report, by Rev. T. N. Hutchinson - - 38
Zoological Report, by J. G. Adamson* and C. M. Chadwick* - 43
On Hippocampus brevirostris, by Rev. T. N. Hutchinson - 44
Geological Report, by W. B. Lowe* - - - - - 47
Entomological Report, by A. F. Buxton*- - - - 50
Botanical Report, by Mr. Kitchener and E. T. Wise - - 54
On Plants found near Harborough Magna, by Rev. A. Bloxam - 55
On a Pelorian form of Linaria vulgaris, by Mr. Kitchener - 57

LIST OF PLATES.

PLATE I. Spectra, drawn by L. Maxwell* - - - 26
PLATE II. Ammonia Engine, by H. N. Hutchinson* - - 28
PLATE III. Flux Motor or Tide Mill, by H. N. Hutchinson* - 30
PLATE IV. Hippocampus brevirostris, by Rev. T. N. Hutchinson 44
PLATE V. Section of Rugby Pit, March, 1872 - - - 47
Diagram showing Drain along Pig-stye Lane, and the Hillmorton and Clifton Roads, by W. B. Lowe* - „
PLATE VI. Section of Strata exposed in Victoria Lime Works, by W. B. Lowe* - - - - - - 48

---

* These are, or were at the time, actual members of the School.

MINUTES OF MEETINGS.

MEETINGS HELD JAN. 27, *MAY* 4, *JUNE* 15, *and SEP.* 18, 1872.

At these meetings only private business was transacted.

MEETING HELD FEB. 17.

Exhibition: Cocoon of Emperor Moth, found on Heather, by J. Armitage.

A Paper by F. A. B. Miller, (member,) was read, '*On the Aurora of Feb. 4th,* 1872, *as observed at Sandgate.*'

H. R. Ricardo read a Paper '*On the Work of the Society,*' detailing a scheme for more practical work in the different sections.

In the discussion which followed this Paper, J. Armitage, G. Darbishire, and the Rev. T. N. Hutchinson took part.

MEETING HELD MARCH 2.

A Paper was read '*On the Earliness of the Season,*' by B. R. Wise, (member,) in which he referred to the plants already in flower, to the insect seen on the wing, to the birds observed already nesting, also to the thermometric averages of the last month.

'The year 1872 may be considered an early one from several considerations; from a comparison of the dates of the appearance of butterflies and flowers, and of eggs being laid as compared with former years, and from the higher average of temperature.

'1. *Butterflies:* Gonepteryx Rhamni (Brimstone) was seen on the wing on Feb. 10th, as also Vanessa Urticæ, and Pieris Rapæ (small white) was observed on Feb. 25th. In 1868 the Brimstone appeared on Feb. 24th, and in 1869 no early date is recorded; it is almost the earliest of butterflies, its eggs being found, according to Wood, as early as April or May. The small tortoise-shell, however, does not usually come out so soon: in 1868 it appeared on April 2nd, and in 1869 on April 12th.

'2. *Birds:* A pair of Hedge-sparrows commenced to build on Feb. 5th. About the same date nests of Tree-sparrow (Fringilla montana,) and House-sparrow (Fringilla domestica) were observed to be begun, and Rooks began to fly in pairs. On Feb. 13th a Blackbird's nest was seen in course of construction. On Feb. 17th a Linnet's nest was seen almost finished; on Feb. 25th, another Linnet's completed.

'3. *Flowers:*	Ranunculus Ficaria (Celandine)	Feb. 15.
	Caltha palustris (Marsh Marigold)	Feb. 15.
	Tussilago Farfara (Coltsfoot)	Feb. 13.
	Viola odorata (Sweet Violet)	Feb. 26.
	Chærophyllum temulum (Chervil)	Feb. 20.
	Corylus Avellana (Hazel)	Jan. 6.

'If we compare these dates of flowerings with those of five preceding years, we shall find that this year is considerably more forward.

NAME.	1867.	1868.	1869.	1870.	1871.
Celandine	Feb. 21	Feb. 23	Feb. 11	Mar. 25	Mar. 14
Marsh Marigold	Apr. 5	Mar. 19	Apr. 8	Apr. 15	Mar. 30
Violet	Feb. 23	Feb. 25	Feb. 15	Mar. 25	Mar. 3
Coltsfoot	Feb. 16	June 22	Feb. 16	Mar. 3	Feb. 23
Chervil	June 1	May 14	Apr. 24	May 5	May 9
Hazel	Feb. 14	Feb. 20	Feb. 13	Mar. 14	Feb. 16

'From the above table it will be seen that all these flowers are above the average, the Marsh Marigold, Chervil, and

Hazel, notably so; being respectively a month, two months, and six weeks earlier than usual. The Hazel which I have mentioned is one which grows in a garden, and therefore, I suppose, cannot be considered quite a fair specimen, although it was only transplanted from the woods last year.

‘4. *Temperature:* When the average heat of January and February of this year is compared with that of the seven preceding years, we find it to be considerably higher.

	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.
‘Jan.		40⅓	32	37	40	35.7	36.1	38.6
Feb.	33¾	37⅓	40½	42	43⅓	34	38.9	40.3

‘The heat of January, 1872, does not at first appear to be much more than usual, but the cause of this is, that in the early part of the month it was cold, but for the latter half the average was 40.3, which is exceedingly high.

‘These notices are, I think, enough to show that this year is more than a month earlier than either of the years 1867, 1868, 1869, or 1870.’

A Paper by Mr. D. Ogilvie, (O.R.), was read, in which he continued his observations on the difference between the Male and Female Sphinges, with reference to the manner in which the wings of the Male are hooked together.

G. Darbishire, (member), then read a Paper referring to the state of the Society, and urging more energy in carrying out the practical work to the Associates. In accordance with his suggestions, a list of sections for practical work was framed, subject to certain regulations.

MEETING HELD MARCH 16.

Exhibitions: Burnt Bank of England Notes, value between One and Two Million Pounds, by J. G. Adamson; A Rattle-Snake's tail and rattle, by F. A. Frost; Toad, found in cavity of a stone, by Mr. Wilson.

Donation: Beetles, by Mr. W. C. Marshall, (hon. member).

The President, and W. B. Lowe, (member), then read the Reports of their respective sections, (Botanical and Geological).

H. O. Arnold, (member), then read a Paper on '*The proposed Submarine Tunnel to connect England and France.*' He explained the form of the tunnel, the difficulties to be experienced in working it, and the Geological character of the ground to be traversed. He also illustrated his lecture with diagrams.

Mr. Wilson, (hon. mem.), then described the Ammonia Engine, as applied to street cars in New Orleans, its economy and cheapness compared to steam. The motive power is ammonia gas, which after every trip is condensed and made to serve again. He illustrated his lecture with a model of the steam engine.

MEETING HELD MAY 11.

Exhibitions: Large Crystals of Selenite, from the cuttings for a deep sewer near the New Gas Works, in the lias; Albertite, a highly-bituminous coal, almost entirely Asphaltum, found in Nova Scotia; and Sulphur beautifully crystallised, from Sicily, by the Rev. T. N. Hutchinson; Sea-Mouse, from Kent, by F. A. B. Miller, (member); Terebratula, from the Red Chalk, Hunstanton, by the President; Wren's Nest, built in a Scotch cap, with six eggs, by R. Cunliffe; Polished Stones, from Sussex, by J. Hume, (associate); Meteoric Stone, by O. Henderson, (associate).

'Deilephila galii,' found in England, by H. Vicars, (associate).

A letter was then read from the Rev. A. Bloxam, (corr. mem.), an extract from which will be found in the Botanical Report.

W. B. Lowe, (member) then read a Paper '*On Coal and Coal-mining in Great Britain.*' He traced the use of coal from its first introduction by the ancients to the present time. He gave an account of the chief sources of coal in England and elsewhere, and supplemented his Paper with statistics of the annual consumption of coal, etc.

Mr. Wilson, (hon. member), made some remarks on the cold week in May. He reminded the Society of a previous* explanation of this phenomenon which had been put before them, ascribing it to the interposition of a meteoric ring, an hypothesis which needed independent evidence to support it, which evidence could only be gained by careful observations on solar radiation, conducted in a more equable climate than our own.

---

* With regard to the Paper on this subject by E. Burchardt, in the Report for 1871, p. 24, Mr. Wilson has sent us the following correction.

'There seems to have been a slight, though not unimportant, mistake in the report of the discussions on this Paper. It was pointed out by Mr. Seabroke and Mr. Wilson that the identification of the hypothetical dust ring that causes the cold week in May with the known meteoric ring that intersects the earth's orbit in November is impossible, on two grounds;

'1st, that the nodes of the meteoric ring are moving directly on the ecliptic, while those of the hypothetical ring must retrograde at the rate of 50″ per annum, if the cold week always comes at the same time of our year.

'2nd, that the meteoric ring intersects the ecliptic nearly at its perihelion; and in its aphelion is as remote as Uranus; forming a highly elliptical orbit, as was shewn by Adams.

'The suggestion made was ingenious, and as far as the knowledge of the author of the Paper extended, was legitimate; but it ought not to be supposed that it met with the approval of the Society.'

He suggested that it might have a terrestrial origin in the following way. During the winter months the continent of Asia is colder than the North Atlantic, and during the summer it is warmer. It is obvious therefore that at some period in the spring as the temperature of Asia rises, that a flow of air must take place from Asia westward, which would be accompanied by a low barometer in Asia and a high barometer over the Atlantic. This would involve a persistent current from the north, bringing with it a corresponding fall in temperature. It would thus be connected with the easterly winds in spring, and would have its counterpart in the November barometric wave and rise of temperature.

Mr. Hutchinson (hon. member) observed that a Paper of Mr. Main's shewed that the Radcliffe observations at Oxford for the last ten years indicated that in April, as well as in May, there was a regular depression of temperature, of which the maximum seemed to follow a curious cyclical law.

Mr. Hutchinson then announced the following donations to the Temple Observatory from Rev. Robert Main, Radcliffe Observer at Oxford.

1. The Radcliffe catalogue of 6317 stars.
2. The Radcliffe catalogue of 2386 stars.

Results of Astronomical and Meteorological observations for the years 1867 and 1868.

MEETING HELD MAY 25.

Exhibition: Monstrous specimen of Polyanthus, by Mr. Hutchinson, (hon. member).

Donations: Fossils from Middle Lias, Cherrington, presented by Mr. J. W. Kirshaw. Fossils from Carboniferous Limestone, Burnley, presented by M. J. Brooks. Ammonites, from Rugby pits, by the President. Three, and Ten-spined Stickle-backs, by A. G. Burchardt, (member).

The President then read a Paper on '*A Pelorian Form of the Toad Flax* (*Linaria vulgaris*,)' found near Hillmorton. (See Botanical Report.)

Mr. Sidgwick, (member), made some remarks regarding 'Clear Wings,' pointing out the instances of 'protective mimicry' to be found in moths.

The President read a letter from the Rev. C. W. Penny, F.L.S., of Wellington College, on '*The Protective Mimicry of Spiders, and their Means of Securing their Prey.*' Three or four spiders were then exhibited. The following is extracted from Mr. Penny's letter.

'You ask me to put on paper what I have observed of the mimicry in Spiders.

'It is now just two years ago since a little boy brought me a curious pink (flesh-coloured) spider, which, as he told me, he had found in a flower clinging to a bee. Two days afterwards I was walking in our heath, and was attracted by the curious attitude of (as I thought) a bee extracting honey from a blossom of *Cnicus pratensis.* Its abdomen was tilted up in the air in a fashion I never saw before, and I stooped to take a closer observation. I then saw that its attitude was due to the fact that a pink spider, indistinguishable in colour from the flower, had fastened its fangs into the neck of the bee, and had drawn its head tightly down into the midst of the florets composing the flower-head. I secured the spider and its victim in a box, and for a long time it continued to walk backwards, dragging the helpless bee round the box. I have since identified the spider as the pink variety (female) of *Thomisus abbreviatus.*

'Last year I secured another specimen simply by inspecting closely the flower-heads of *Cnicus pratensis.* You will find that *Thomisus abbreviatus* is described in books as a yellow spider with pink spots, and I was fortunate enough to get one last week; so I send it you. But it is the first *yellow* one I have seen. All the others I have met with are a bright pink, the colour of uncooked meat.

'You will observe then that I have met with three cases of mimicry with *Thomisus abbreviatus*; the delusion is perfect even to the human eye, and in each case it has been the victim that has drawn attention to the flower. In no case has the spider been distinguishable in colour from the flower, until observed closely.

'Last year I was walking along the Blackwater, when I saw a bee (as I thought) hanging as if glued, by the tip of its abdomen, to a blossom of *Barbarea vulgaris.* I stooped down to ascertain the cause of this, and saw what at first sight I thought was a monstrous pistil with five lobes; but the lobes began to move, and I perceived that my friend the bee was simply having his mortal juices sucked out by a large yellow specimen of *Thomisus citreus.* In colour it was quite indistinguishable from Barbarea vulgaris, and even after I had picked it and held it quite close to my face, I did not at first perceive what had really happened. I have had a specimen of *Thomisus citreus* brought me this afternoon, and send it to you. I should add that my first impressions of the victims to this mimicry being bees, was wrong. They were bee-like *dipterous* insects, of which your Society will need no description.

'This term I have had a fresh example. *Thomisus citreus* has a white or greenish-white variety, and a specimen of this colour was brought me, which had deluded a fly by lurking in the corolla of a blossom of *Stellaria holostea.* The boy assured me that it was the position of the fly which caused him to inspect the flower, and he did not at first see what was the matter, and that it was only by accident that he saw the spider. I have had this spider a fortnight, and it is somewhat faded so that you might scarcely think the deception as good in this case as the other two. But when it was brought to me the delusion was perfect.

'I send you cocoons of *Agelena brunnea,* one fresh, one daubed with mud. They are very common here, and may be so with you. The daubing with mud is another, though different, instance of unconscious mimicry. I have proved to my own satisfaction that when the mud is washed off, the decanter-like cocoon is underneath.

'I hope I have made it clear that in the above three cases the flies were deceived by the pink *Thomisus abbreviatus* lurking in the pink *Cnicus pratensis,* the yellow *Thomisus citreus* lurking in the yellow blossom of *Barbarea vulgaris,* and the white *Thomisus citreus* in the white blossom of *Stellaria holostea.*'

MEETING HELD JUNE 15.

An extraordinary meeting of members and associates was held to discuss the plans for a Field Day for the Society.

MEETING HELD JUNE 22.

Exhibitions: Sepals of Primrose becoming Leafy, by Mr. Wilson; Skins of Mice, by A. G. Burchardt; Fuschia with Leafy Calyx, by F. R. Hodgson.

E. T. Wise, (member), read a Paper on '*The Habits of Moles,*' illustrating his remarks with diagrams.

Mr. Wilson, (hon. member), then gave a *resumé* of his Paper for the Royal Astronomical Society, on '*The Orbit of the Double Star, Castor*': the object of the Paper was to show that the orbit is perhaps a hyperbola, and not an ellipse.

FIELD DAY HELD JUNE 28.

Expedition of 40 members and associates to Birmingham. Mr. Wilson, Mr. T. N. Hutchinson, Mr. Seabroke, and Mr.

Ker took charge of the party. One division visited Elkington's Electro-Plate Works, the Mint, and Brass Foundry: the other visited Gillott's Steel Pen Manufactory, and the Small Arms Factory.

FIELD DAY HELD JULY 6.

Mr. Sidgwick took a party of about 40 to Charnwood Forest, the Beacon, and Bardon Wood; the chief objects of the excursion were entomological and botanical.

MEETING HELD OCT. 5.

Exhibitions: Vanessa antiopa, by J. R. Hutchinson; Chalina occulata, a British Sponge from Langland Bay, South Wales; also Living Sponges on Rock, in sea water, by Rev. T. N. Hutchinson; Petrified Moss from Coalport, by E. T. Wise; Reseda lutea (new locality), from Clifton, and Linaria vulgaris, var. peloria, by the President; Weasels' Skulls, by A. G. Burchardt.

Letters on Botanical subjects from H. G. Wauton, (member), and Rev. A. Bloxam, (corr. member), were read.

A Paper was then read by A. G. Burchardt, (mem.), on '*The Work of the Anatomical Section,*' from which we subjoin the following extracts:—

'Ever since I first became an associate of this Society, I have wondered that so few took any interest in the habits, nature, or classification of the animals which abound in this neighbourhood.

'There are always many associates and members who devote their attention and time to the study of botany, and of entomology, but few know even what sort of animals are to be found in this district.

'It is true that they are not so numerous as birds, moths, and butterflies, but then their habits are so interesting that I cannot understand how it is that they have been hitherto so neglected. There is another reason why they should be popular with beginners: they are larger, and therefore easier to dissect, than moths and butterflies, and no one can be worthy of the name of a naturalist who does not seek to know more than the names of his specimens.

'Now insects cannot be examined and dissected without the aid of a microscope and delicate instruments, but it is easy to obtain some idea of the anatomy of a rat or weasel with only a penknife and a pair of sharp-pointed scissors.

'But it may be asked, What animals are there? That is exactly what I wish to find out. The question for this Society is, What are the animals found in the Rugby district?

'We know what fossils and plants there are, but the animals have been almost entirely passed over.

'The easiest to catch and examine are the rodents; of these w ehave the squirrel, the dormouse, the common rat, and perhaps the old black rat (but of this I am not sure), the water rat or rather the water vole, the short-tailed field mouse or field vole, the long-tailed field mouse or wood mouse, and of course the rabbit and hare.

'Of the three English shrews I have found two, the common and the water shrew. The mole and hedgehog are singularly abundant. The stoat and weasel are the only representatives of the carnivora. I have not yet seen any specimens of the harvest mouse, but I hope that any member who finds one will secure it for the Society.

'I have once seen a black rat here, but I do not know if it was a specimen of the old English black rat, or a black water rat, such as are found in Scotland. The black rat is nearly extinct in England, but in Scotland the water rats are black, although there is no other difference between them and the English variety.

'This is hard to account for, but perhaps it is an instance of natural selection, black being a warmer colour, and therefore more suited to the colder climate of Scotland.

'The first thing to do on procuring a new specimen is to skin it and preserve the skin; this can be easily done by stretching it on a board with pins and rubbing it with salt and alum. It requires three or four days to cure the skin of a small animal.

'It is better when skinning to leave the feet and tail attached to the skin, unless the whole skeleton is required. The autumn and winter are the best seasons for collecting skins, for then the fur is thick and close, but if they are animals which, like the stoat, change colour in the winter, it would be better to get two skins, one taken in the summer, the other in the winter. Skins prepared in this way are very useful for identifying specimens, for instance, in books all the different species of rats and voles are described as having reddish brown fur, and yet no two are alike in colour.

'If you wish to prepare the whole skeleton, the best method is to remove as much flesh as possible, without dividing the bones, then to expose it in the open air in some secure place and allow the maggots and beetles to clean it. If the animal is small, the black or red ants will pick it, but the yellow ants are no good. Wasps and cockroaches are said to do this too, but of this I cannot be certain. The bones can then be dipped in warm water and cleaned, and as fast as they are ready, they should be cemented together to avoid confusion.

'The vertebræ should be threaded on a thick wire and cemented to each other, and the wire can then be bent in the shape of the animal's neck and back.

'Gum or guttapercha cement is the best for joining small bones, but the larger ones must be fastened with wire.

'If it is not possible to preserve the whole skeleton, the best plan is to prepare the skull, which may be cleaned in the way before mentioned or macerated in water, a somewhat unpleasant task when the time comes to open the bottle.

'They generally require about three weeks maceration, and then they must be washed and dipped in a solution of chloride of lime, to remove the smell. The merry-thoughts and breast bones of birds are well worth preserving. One of the most peculiar is the bustard, now extinct in England. The fork of the merry-thought is grown up with bone except a hole, through which the windpipe passes.

* * * * * *

'Curious deformities are often found in skulls. I have here the skulls of some weasels, which have a swelling between the eyes, and with small holes in each swelling. I have never found this in stoats' skulls, but out of eight weasels I have got in this neighbourhood, seven had this deformity. Not even the young ones seem free of it, for one of these skulls is that of a weasel not half-grown. I think this may have been caused by some parasite, which has entered the nostril and caused a swelling. I think I have now said enough to show that there is much work to be done in this branch, and I hope that these subjects will receive some of the attention it deserves, and which has been so profusely accorded to the other branches.'

The President reported to the Society his observations for this year on the Pelorian Toadflax, growing at Clifton, (see report of the Botanical Section).

MEETING HELD OCT. 19.

Exhibitions: Glass Rope Sponge, by Rev. T. N. Hutchinson; Mouse and Toad entirely Dried up, from cavities in rock at Filey, by Mr. Billington; Mica schist from New Bilton drift; Ammonites angulatus, 2 specimens, from clay by Railway Station; Granular Quartzite, etc., by Mr. Wilson; Bark Stripped off by Lightning, by A. M. Worthington; Lava from Vesuvius, thrown up in the recent eruption, by L. Maxwell; Fossil Fish from Old Red Sandstone of Stromness Orkney, by Mr. Spurling.

E. J. Taylor, (associate), read the following Paper on '*A Visit to Norway,*' illustrated by numerous photographs.

'The Hardanger Fiord, which is a little south of Bergen, is one of the largest and finest in Norway: at the head of it lies Odde, where our party, 8 in number, arrived by steamer late in the evening of August the 20th. The heads of most fiords have a strong family likeness, and all we saw afterwards had for the most part the same general features as this one;—there is a rough shingly beach rising by a very gradual slope to the elevation of six feet above the fiord, where it forms a flat plain across the bottom of the valley. From this there rise up terraces or raised beaches,—the two best marked of 60 ft. and 270 ft. in height respectively,—and have the appearance of two huge railway embankments, being flat at the top or sloping very slightly seawards, and bounded by a steep incline at an angle of about 45°: besides these two there are traces of six other terraces less strongly marked. Through all this a rapid stream rushes, which has its origin in the lake and glacier above: this stream in cutting a channel for itself has swept away a considerable portion of the raised beaches; undermining them, especially at sharp bends, in its course where the terrace above is worn away into a precipitous scree, down which the drift gravel and moraine matter of which it is composed is perpetually rolling. The flat tops of the beaches are cultivated, and it is on the lowest of them that Oddé stands, with its four or five scattered houses, its two inns, and a church, all of wood.

'Early on the morning of the 21st we started for the Buerbrae glacier, ascending the valley which faces the north, and Messrs. Wilson and Sidgwick, never having been there before, are at once constituted guides. The path runs straight up the valley, ascending to the top of the highest raised beach, and the section of the road reveals the composition of these terraces, which are made up of drift gravel and general moraine, the whole having been once the terminal moraine of a great glacier which filled the valley from side to side, as is seen from the glaciation of the rocks which extends almost up to the highest visible summits, some 3,000 feet up. The presence of the beaches is accounted for as follows:—the sea once stood at the level of the top of the moraine, where the highest raised beach now is; into the shallow water the force of the glacier stream spread out the moraine matter into a flat delta sloping slightly seaward (just as it is now doing at the bottom), and this forms the surface of the first raised beach: the land was then slowly upheaved for some time, so that the sea fell lower and lower, till a pause or at least a slackening of the upheaval took place, and another flat surface or terrace was produced; and so on down to the present level of the sea: the glacier stream meanwhile cut its way through the beaches, keeping pace more or less with the receding sea level.

'After walking about a mile on the top level we turn to the right, across the shoulder of a hill, in order to strike into a narrow valley that runs up eastward, at the head of which lies the glacier. Here we unwisely ascended to a height of about a thousand feet over the shoulder of the hill, and then along the north side of this eastern valley, where the mountain was well wooded with birch, hazel, and ash, but extremely rough, being strewed with what had been a lateral moraine of the glacier which had once extended far down the valley. As we advanced the ground became rougher, the masses of rock that had formed the moraine more huge, and ultimately we had to descend to the foaming stream below, which ran through a flat meadow about three hundred yards wide and afforded easy walking—in fact, if we had been without guides, we should naturally have chosen this way at first. Our course now lay up the side of the stream, and after a walk of 1½ hours we came in sight of the glacier, and the ascent became more rapid till we reached the object of our expedition.

'The Buerbrae is one of the largest glaciers which come down from the great snowfield of the Folgefond, about 6,000 feet high: it is fed by two streams of ice which are separated by a huge precipice of rock which stands out in the middle at the height of about 3,500 feet above the sea, and over which a large waterfall pours from the melting of the snow and ice above: this stream is one of the main sources of the torrent which emerges from underneath the glacier at its foot. The two ice streams passing on each side of this jutting-out precipice carry with them masses of rock and stones, which they scrape off in their course, and these form a medial moraine, *i.e.*, a streak of rock, stones, and dirt, which runs like a backbone down the middle of the glacier from this point to the foot. It is from this moraine that stones are perpetually gliding and rolling down the sides of the glacier, demanding a sharp look-out from any-one who would pass along under the side of it.

'The Buerbrae is one of the most rapidly advancing glaciers known, as it moves forward at the rate of ninety yards a year (nearly nine inches a day), and is increasing its pace: this movement is caused simply by its own weight. The end of the glacier now occupies the site of a chalet that was standing but a year or two ago: this lower end is now only about 1,145 feet above the sea, and owing to its rapid movement changes its form every year: as we saw it, it resembled a huge buttress some forty feet high with a pointed top, rather overhanging. The beauty of the blue ice crevices and caverns at the extremity of the glacier is extreme. The blue is deepest where the crevices are deepest, and fades from a very dark blue in the recesses to a pale ultramarine colour at the edges, where it has an almost unearthly tint. This blue is the natural colour of pure ice or water, but is not visible except in large masses; and the reason that it is so much more pale at the edges is because it is not pure ice; there is snow on the top, which is white; the snow by pressure melts and freezes again into ice when it regains the natural colour of pure water, *i.e.* blue: it is also possible that the light at the edges of the glacier has something to do with the paleness of the blue there.

'After admiring the beauties of the foot of the glacier, and refreshing the inner man, we started up the north side with the intention of ascending it, and getting on to the medial moraine. Between the side of the glacier and the mountain that bounds the valley is a sort of chasm half filled up with moraine matter, some of which had slipped off from the top of the glacier, but much more had been torn off from the mountain side quite recently: we tried more than once to climb up the side of the glacier on to the top of it, but it was too steep for us, as the only thing we had for an ice axe was a decayed geological hammer, which 'gave out' at the third step.

'The foot of the glacier was acting as a plough, having torn up all the grass in front and around it: it had not gone in very deep,—only about a foot, in fact,—because it was in the track of an old glacier: we noticed in particular one huge piece of rock which had been detached from the mountain side, and was beginning its course downwards. People wonder how ice which crumbles can wear away such a hard substance as rock;—it does not wear it away, it pushes it away; it catches every corner of rock which is jutting out, especially if it points up the valley, and pushing it, as it were, out of its socket it carries it away.

'Climbing a little up the valley side we got somewhat above the body of the glacier, and saw to advantage the parabolical dirtbands, which are successive bands on the glacier rendered visible by the dirt accumulating on it; they at first ran straight across the glacier, but as the centre moved faster than the sides, the straight line is changed into a curve with the vertex pointing downwards. From our high standing point at the side we could also see in the medial moraine and scattered generally over the back of the glacier huge blocks of rock, sometimes perched on a pinnacle of ice, all being borne downwards and away from their parent mountain. We noticed also what is called the stratification of the glacier, being a series of parallel horizontal lines a few inches apart, and seen best at vertical sections, distinguishing by a slight difference of colour or texture the ice due to the snow of one year from that of the next.

'Before we turned to depart Mr. Wilson made a list of some of the plants he found by the glacier side:—they were alchemilla, jasione, rose, strawberry, raspberry, blackberry, crowfoot, willow herb (large and small), antirrhinum, rhinanthus, eyebright, potentilla, foxglove, pansy, starwort, campion, campanula, saxifrage, golden rod, and the holly and beech fern.

'Returning we did not again cross the shoulder that separated our branch valley from the main Odde valley, but kept alongside the stream till it emptied itself into a lake, to emerge again at a distance of only a mile or two below, and cut its way down through the raised beaches to the fiord at Odde. We had seen this lake from above in the morning, and had noticed that the mud of the glacier stream was carried far out into the middle, and was fast setting it up with mud banks, round which we had now to row to the lower end. The origin of this lake is accounted for in the following way:—the greater part of Scandinavia is being at this moment, and has been for a long time, slowly upheaved: but this upheaval is neither regular nor uniform, for in some parts there is actually a loss of land, in others there is but a gain of a few inches in a century, while in others again it is several feet. Hence it is probable that this lake, which is now 300 feet or more above the fiord, was once part of the fiord itself; and that an upheaval has raised the land, and so accounted for the raised beaches: while the lake was formed by the terminal moraine of a great glacier coming down the valley and forming a great dam, while the water of the lake escaped in a foaming stream at one corner. There are traces of the moraine of the main glacier. On the shore of the lake at the lower end were lying some huge boulders, some of them as big as decent-sized cottages, which the glacier was probably glad to be relieved of. All down the raised beaches, too, were smaller boulders, reaching almost down to the present level of the fiord.'

Mr. Wilson, (hon. mem.) who was one of the party, then further explained the formation of the raised beaches alluded to above.

Mr. Sidgwick, (member), exhibited Acronyita alni, captured in Charnwood Forest, together with other moths presented to the Society by F. W. Dutton and H. Vicars.

MEETING HELD NOV. 2.

A vote of thanks was passed to Mr. Wheeler, late clerk of the works at Rugby Chapel, for his assistance in taking the Meteorological observations during the holidays for some time past. A copy of the Society's Reports since 1867 was presented to Mr. Wheeler.

The Society's prize was awarded by the President to L. Maxwell, (member), for an Essay on '*Spectrum Analysis.*' The second prize was taken by H. N. Hutchinson, (associate), for an Essay on '*Motive Power.*'

Exhibitions: Pair of living Sea Horses (Hippocampus brevirostris), by Rev. T. N. Hutchinson; Polished Pebbles from near Rugby, by Mr. Wilson; Arctic Coral, and other Norwegian curiosities, by A. W. L. Boyd; Fossils from Bromwich's pits, by F. R. Hodgson.

Mr. Wilson explained an arrangement lately completed by Mr. G. M. Seabroke, (corr. mem.), at the Temple Observatory for viewing the sun's chromosphere (see Astronomical report).

L. Maxwell, (member), then read the following Essay on '*Spectrum Analysis,*' which, together with the accompanying drawings from the microspectroscope, had obtained the Society's prize.

'Of all the discoveries which have been made during the last few years in every branch of science, none, certainly, have proved more wonderful or interesting than that of spectrum analysis, and without doubt none, since its birth, has made such great progress, or proved itself more likely to become of greater practical utility. The term 'spectrum analysis' implies a resolving into its component parts, by optical means, any body of unknown constitution:—it is, in fact, an analyser. By this, of course, we do not mean that it actually decomposes substances, but that it is a valuable aid either, in the first place, in making a qualitative analysis of any substance in the Laboratory, where the substance under examination is, of course, in our hands; or, in the second place, in the Observatory, in determining the actual chemical composition of the sun, our own system, and even the fixed stars—in fact, of any source of light sufficiently intense to bear decomposition. Let me here say, in starting, that I shall not so much attempt to explain the *principle* of the spectroscope, which has been already done by Mr. Hutchinson in a Paper read on the 1st May, 1869, but rather, supposing the principle to be understood by all, speak of the purposes to which this instrument has been applied, and more especially the investigation of absorption spectra.

'There are, then, two kinds of spectra, (1) bright line, and (2) absorption spectra. The bright line spectra are produced when the light emitted from certain solids, such as thin wires of the different metals, made incandescent by being placed between the poles of a powerful electrical battery and coil; or gases, in a very rarefied condition, also made incandescent by the electrical spark being passed through them, as in Plücker's tubes, is examined in the spectroscope. Now to the eye alone two thin points of incandescent platinum, silver, or magnesium wire, would appear simply to be at a brilliant white heat; but when this apparently white light is examined in the spectroscope, a brilliant continuous spectrum is seen, upon the top of which, as it were, numerous bright lines of every intensity are seen; these bright lines being characteristic of the various chemical elements. So also when a highly rarefied gas, enclosed in a Geissler's tube, is rendered incandescent by the electric spark, in some cases it appears red, in some green, and various colours, depending, of course, upon the nature of the gas. Yet if such incandescent gas be examined with the spectroscope, sometimes a continuous spectrum crossed with bright lines, sometimes bright lines alone, varying in number, position, and intensity with the temperature of the gas, are seen, peculiar to, and characteristic of each gas. Thus we see the use of the bright line spectrum; although each of the sixty-three chemical elements has been made to give a bright line spectrum, and in each of these sixty-three spectra there are numerous bright lines, those in the spectra of some elements, iron, sulphur, titanium, and the air spectrum, especially, being almost innumerable: yet each element has lines peculiar to itself, and in no case have two lines belonging to two different substances been known actually to coincide, however near they may lie together. Thus we see that the bright lines, &c., as seen in the spectroscope, emitted by each element when its temperature is raised so that it gives out light, are characteristic and indicative of each element: and any one familiar with these spectra can tell at once by noticing these bright lines, what element is under examination. Such is the use of the bright line spectrum, which is the one always used in examining a substance spectroscopically. But to use it a great deal of apparatus is necessary. First, a Bunsen's burner, or, if higher temperatures are required, a powerful electrical battery, coil, intensifiers, &c., are required. Secondly, the spectroscope used, if important and accurate results are to be obtained, must possess a very great dispersive power, so that the lines may not be huddled up together, and all the intense light be concentrated into a short spectrum; but that the spectrum being elongated, and the light thus more dispersed and softened, the bright lines may be well clear of one another. A spectroscope possessing such dispersive power would be, owing to the price of flint-glass prisms, very expensive.

'We thus see that although the bright line department of spectrum analysis is the most important, yet by reason of the amount and cost of the apparatus necessary for it, it is out of the reach of amateurs, that is to say, of those who cannot afford either the time or the money which must be devoted to it. Now it is just on this account, I think, that the minor department of spectrum analysis, the investigation of absorption spectra, is so attractive. There is no cumbersome apparatus, no gas flame needed: all we want is the light of a candle, and a spectroscope of no great size or dispersive power. But before I proceed to expatiate on its merits, let me attempt to explain the principle, which principle cannot be understood without knowing a little about the colours of natural objects. Now the most apparent and evident distinction between natural objects, as regards the sense of sight, is that of colour; and it may seem an unnecessary question to ask how these colours are produced. One would say at once that the distinction lies in the nature of the objects themselves, and on first thought one would not take into account the influence of light on colour; yet it is evident that light must be very essential to colour, for in the dark, of course, colours cannot be distinguished. The first conclusion, therefore, that we arrive at is, that *colour is dependent on light,* for in the absence of light colour cannot exist. But we must make a further distinction between daylight and artificial light, as regards their effects on colour; the dress which in the daylight appears of a beautiful violet, appears dull and black by gaslight. By gaslight also green is indistinguishable from blue; and if a landscape be viewed through a tinted glass, all objects appear of the colour of the glass. These facts and many others seem to prove that colours are *not inherent* in objects, but that they are produced by some *extraneous* cause. Again, a final illustration, if some salt be rubbed into the wick of a spirit-lamp, and surrounding objects be viewed by the yellow flame thus produced, their colours disappear, or lose much of their brilliancy, and everything seems in mere light and shade, and of a dull grey hue. This then seems to prove that there must be something in the objects themselves to help in the formation of colour, for in this last instance the surrounding objects in no way assume the yellow colour of the light illuminating them, but appear, as a rule, of quite a different hue. We might go on multiplying such instances *ad nauseam,* but will save ourselves this trouble by at once enunciating the true explanation, which is this; *the natural colour of an object is that in which it appears by daylight.* Now if an object be illuminated by pure white light and yet appear of another colour, the cause of the difference must be looked for in the influence which the surface of the body exerts on the ether waves constituting white light. The effects of this influence are very different, according to the nature of the colouring matter with which the object is provided; but they may be mostly reduced to one of two cases; (1) when a portion of the ether motion is entirely stopped, or partially weakened in its passage over the surface of the substance, in which case the rays of light are said to be *absorbed;* or (2) when the ether waves are irregularly reflected from the surface of the object, as sometimes occurs with the waves of sound; in which case they are said to be *scattered.* When the surface of a body has the property of absorbing all the colours which make up white light except one—the red, for example—then that body appears red by daylight, because the yellow, green, blue, and violet are held imprisoned, and the red alone is allowed to go on to the eye; and so with all other colours. Now as white light contains the whole range of colours visible in the spectrum, it can easily be understood why, owing to the different reflective qualities of different substances, we see such an infinite variety of tints in nature. * * * *

'So far we have only been considering the *reflection* of light, whether altered or unaltered, from the *external* surfaces of bodies: let us now see what happens when light passes through a *transparent* substance; which is nearer our subject. Most substances, when placed in the path of rays of light, either weaken or stop these rays. Thus colourless glass lets light through with very little diminution, and an opaque body transmits none, but reflects and diffuses all light from its surface. But there is a third case, namely, when light passes through a coloured transparent medium, such as coloured glass: in such a case the coloured glass only lets pass that colour of the whole spectrum which falls upon it which is of the same wave-length (or colour) as itself, and retains all the rest. Thus red glass lets pass only red light, and retains green, blue, and violet; a blue glass lets pass only blue light and absorbs red, green, and violet.

It is not, however, strictly true that coloured glass is transparent for one colour only; most kinds of glass absorb rays of certain colours, and allow the others to pass through in very different proportions. We are unable to decide which of the coloured rays are transmitted through a coloured glass unless we make use of a spectroscope. By this means we shall see that the red glass transmits some orange and even some yellow rays with the red, and that the blue glass transmits some violet and green rays, besides the blue. But, in addition to this, some transparent media, such as coloured liquids and gases, exert a *selective* influence on white light: *i.e.* instead of generally weakening the entire spectrum throughout, or absorbing all the blue, or all the red, they create gaps, dark bands, or fine lines, precisely analogous to the bright lines characteristic of incandescent gases or metals, scattered throughout the whole length of the spectrum, and characteristic of different substances. Upon this fact rests the principle of absorption spectra, which is useful in the same way as the bright line spectrum; only in this case the liquid or gas to be examined is interposed between some source of light and the slit of the spectroscope: here it sifts out, and retains light of certain wave-length from the rays of white light which pass through it, which is shown in the spectrum created by the decomposition of the light in a prism by certain gaps, and dark lines throughout the spectrum, which dark lines, as said before, are characteristic of various substances.

'The absorptive power of coloured liquids is generally much more decided than that of coloured glass. Several coloured liquids also exert a selective influence upon white light; marked instances of this are chlorophyll, the green colouring matter of leaves; a solution of human blood; and numerous chemical substances. The work, therefore, that is to be done in this division of spectrum analysis consists in taking both such liquids as are well known to produce characteristic absorption spectra, and accurately examining and drawing their spectra; and also trying all kinds of liquids, solutions in alcohol or ether of the colouring matter of leaves and flowers, and all kinds of chemical compounds; —in fact, in examining *any coloured liquid*, to see what effect it produces on white light. The field thus presented for experiment and work is boundless, nor does it require anything beyond careful measurements, and, of course, an interest in the subject, to succeed in it. In plate I. are represented some selections from a few drawings of various absorption spectra done during the holidays: they are, of course, excessively rough, as they were done when I had only just began to take up the subject; they may therefore serve merely to give some idea of the effect produced on a continuous spectrum when such media are interposed in the path of the rays of light; certainly not as accurate measurements. Some of these results were obtained with the *micro-spectroscope*, a most admirable little instrument, specially intended for the investigation of absorption spectra: but of which space will not permit me to give a description here.

‘* * But perhaps the idea will arise in the mind of any one who thinks over this, that there must be some relation between the characteristic bright lines emitted by an incandescent gas, and the gaps created in a continuous spectrum by the same gas absorbing light of a certain wave-length; that is, between the emission and absorption of light by the same substance. Now as early as 1853, Angström, a celebrated German chemist, gave expression to the general law that a gas when luminous "emits rays of light of the same refrangibility as those which it has the power to absorb;" yet all these facts remained isolated until Kirchhoff, in 1860, published the celebrated law, which is one of the most fundamental principles of spectrum analysis, viz.; that "the relation between the power of emission and the power of absorption of one and the same class of rays is the same for all bodies at the same temperature."

‘I ought not here to omit mentioning the highly *practical* purposes to which the method of absorption spectra is now being applied; namely, to the investigation of articles of commerce, such as dyes and wine, to ascertain its age; as well as to detect the adulteration in food, such as beer and wine, mustard, cheese, butter, &c.;—in fact its range is almost unlimited. One office, especially, of the highest importance, this means of test promises to fulfil: in all medico-legal investigations, such as in cases where poisoning is suspected, owing to the almost infinite delicacy of spectrum reactions, spectrum analysis will offer an infallible means of detection, as the characteristic absorption spectrum of human blood is most wonderfully altered by the presence of the smallest particle of any foreign element. This is illustrated in the four first specimens in plate I.*

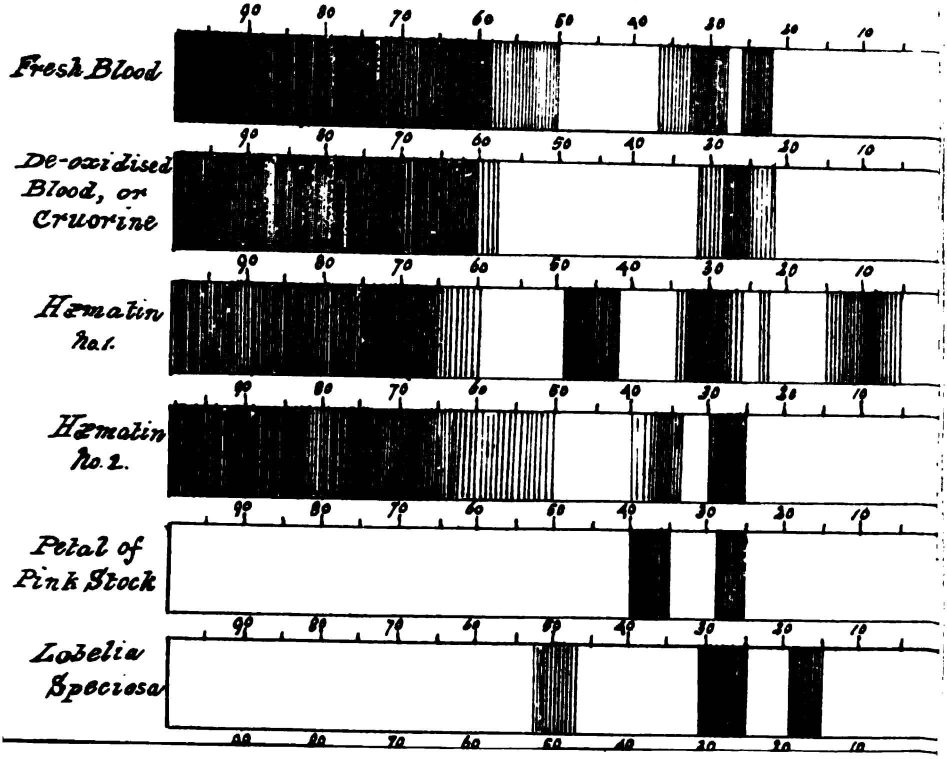
'I think I have now said nearly enough to show that this branch of spectrum analysis, the examination of absorption spectra, is open to anyone taking an interest in the subject; yet of course correct measurements, as in all similar cases, can only be obtained by taking an average of several independent observations. Two or more observers, therefore, can most advantageously work together at the same subjects, and compare their measurements; and by such a co-operation of observers, no matter how distant from one another, excellent results may be obtained. One practical difficulty, however, stands in the way of such co-operation, namely, the employment of different scales in the mapping of spectra. Some spectroscopes are provided with an illuminated photograph-millimetre scale fixed in the eye-piece, some with a scale of angular deviations, and some with a micrometer screw. How, then, are the different readings obtained with such scales to be compared with one another, so as to obtain an average? It is clear that any method of measurement which is to be applicable to observations made with different spectroscopes must be independent of any peculiar construction of the instruments, the number, position, and refracting angle of the prisms, the dispersive power of the glass, and of all such causes of difference. In such a method it is clear that each line can be mapped only by means of its *colour;* that is to say, all results obtained with the prism must be *reduced to wave-lengths.* For this purpose we

---

* In plate I. spectra 2, 3, 4, 14 are taken from Schellen's Spectrum Analysis; the rest are original.

PLATE. I.

Specimens of Absorption Spectra.



must possess an accurate table of the wave-lengths of the spectral lines of the elements; we can then easily determine the wave-lengths of the lines of any new spectrum with as much accuracy as the dispersive power of the spectroscope employed will allow. All we have to do is to find two known lines, between which the line to be measured falls, and from their known wave-lengths to calculate the wave-length of the new line; which can be done by two methods, (1) that of *graphical interpolation*, or (2) by an interpolation formula. Now for all like myself the second method will not do, since it requires some considerable knowledge of mathematics and algebra to employ it; I should therefore recommend the first method, in which one can hardly go wrong. A large sheet of paper, say about 3 feet square, ruled into small squares, (such paper, ready ruled into inches and tenths, is sold in London) is taken; along one edge of it is marked off a scale of wave-lengths; and the edge at right angles to that has a scale marked on it corresponding to the scale of the spectroscope used. The positions of as many lines as possible—the more the better—are then mapped on the paper, and through these points a curve is drawn as evenly as possible. Then the position of any line whose wave-length is to be ascertained, being found on this curve, will have opposite to it the wave-length required on the scale of wave-lengths.'

After the Paper a number of experiments in spectrum analysis were exhibited.

MEETING HELD NOV. 16.

The Rev. T. N. Hutchinson made some interesting remarks, the result of his own experience, on the subject of his Hippocampi (see Zoological report).

The President then read a Paper by V. H. Veley, (associate), on '*Phosphoresence*,' one of the unsuccessful Essays for the Society's prize.

Mr. Hutchinson went further into the subject and spoke of the '*Noctiluca,*' a subject not mentioned in the preceding paper.

H. N. Hutchinson then read a Paper on '*Motive Power,*' from which we extract the following. This paper had obtained the Society's second prize.

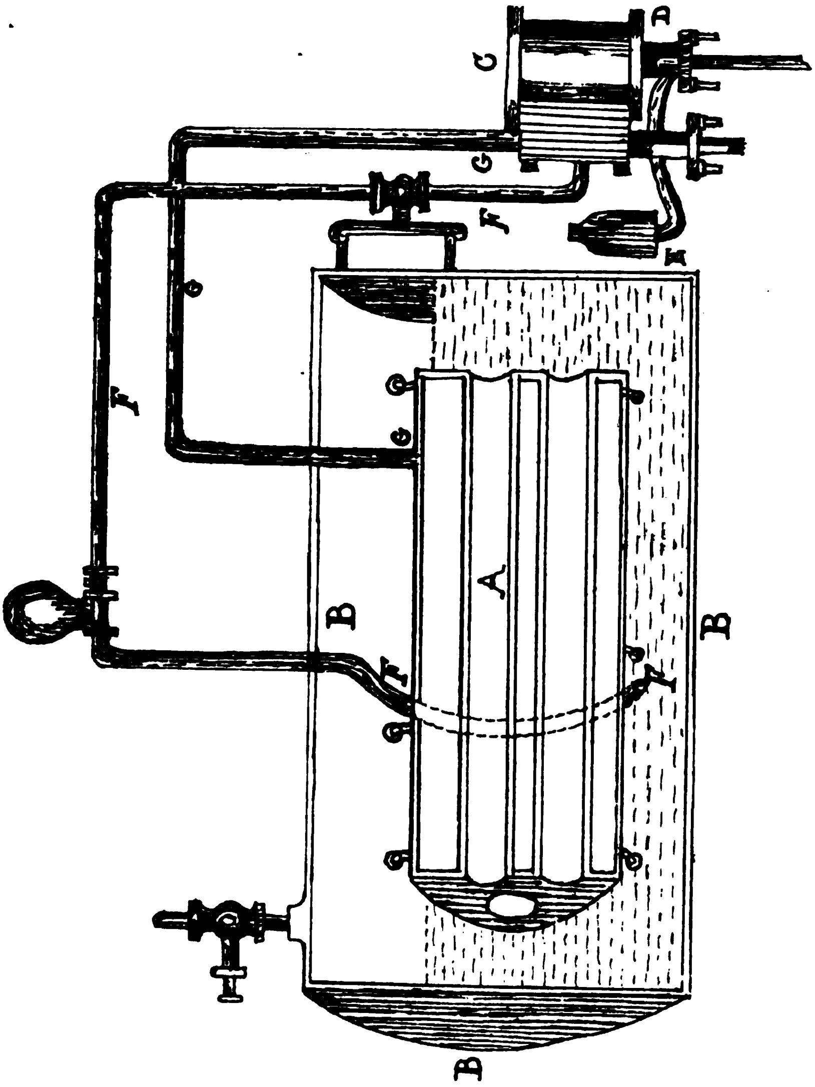
'The subject of motive power is one of extreme importance; indeed it would be difficult to find one which concerns the nation to a greater degree. For now that the steam engine is being so extensively used in almost every part of the world, it becomes us to be careful with the fuel used by steam engines, and to see in what way we may economise it most by applying the known laws of chemistry and heat; and not only to be careful with our coal, but to see in what cases we may use other powers instead of steam, as ammonia, electricity, or water, and so in some degree stop the enormous consumption of coal which we all know to be going on.

'Now in this matter of using new motive powers our Transatlantic cousins are ahead of us, for they have started an "Ammonia Propelling Company" in Orleans. Let us go briefly over the chief parts of their ingenious ammonia engine.

'The principal ground for using ammonia is that it requires much less heat to convert it into vapour than water does. There are however many practical difficulties to be overcome. Its theory may be said to be this.

'Ammonia gas is liquified by great pressure and put into vessels of strong iron, as A (plate II.) By pipes G from these vessels the gas given off by the liquified ammonia expands, and on account of its high pressure works an ordinary piston C. After it has done its work here it is not allowed to escape, but is brought back by pipes F into a vessel B containing water which surrounds the vessel A containing the iron pipes mentioned above. Here it is dissolved as fast as it comes from the cylinder C. Now when

Plat



AMMONIA ENGINE.

H.N.H.

all the gas from these iron pipes is used up, it has not been wasted, but dissolved in the water surrounding the pipes A, and can be driven off from this water and subjected to a great pressure and so make more liquified ammonia gas to fill the pipes A again. Now as the ammonia gas dissolves in the water it gives rise to heat, but not enough to keep the engine working, so that a small fire is kept up under the boiler. But the consumption is very small. I think that the drawing will explain and make clear what I have said. D is a packing-case with oil in it to prevent leakage. E is a supply of oil.

'Attempts have been made to work engines with other expansive liquids, as ether, and carbon bisulphide, which vaporise at a still lower temperature, but without success.

'*Carbonic acid engine.*—I have never seen or even heard of a carbonic acid engine, but I have often noticed the great force shown by this gas under pressure, especially in soda water bottles. My attention was first drawn to the subject of working engines with this gas by quite an accident. About a year ago, my brother and I were working a small model steam engine. Soon we used up all our spirits of wine, and not having a gas-burner we thought whether we could work it by any other means. Carbonic acid suggested itself, so we took a strong glass bottle in which to generate the gas and to act the part of a boiler. It had two mouths, so we connected one with the engine and used the other to put the chemicals in. We only had carbonate of soda and vinegar. When we thought the pressure was "up" we turned the tap of the engines and it worked fast only for a short time, for the pressure soon went down, and we had to put in more chemicals. But I think that with hydrochloric acid instead of vinegar, and a boiler suitably constructed, so that acid could be poured upon the carbonate of soda by a tap communicating with the outside, a good result might be obtained. I should propose using carbonate of lime instead of carbonate of soda. It would want stirring up, but this could be done by a handle outside, made to work by the engine. Now it would never do to let the carbonic acid escape into the air. But I propose to get it back (only in another form) as the

three hours of rest, until the next rise of the tide, when the engine again begins to work.

'If a longer period of work be required it is possible to put on force pumps, to be worked by night tides, and compress air into the receptacle N, where it would be ready for use.

'The advantages of the flux motor are that it is an irresistible force; it can always be depended upon; it uses no fuel; and that the engine may be placed some miles inland, and worked by pipes leading to a receptacle on the sea coast.'

MEETING HELD NOV. 30.

The Rev. C. J. E. Smith, (hon. mem.), gave a Lecture in Big School, to a meeting of more than 200, on the Organ then in course of construction for the School Chapel.

The Lecture was divided into three heads, (1) the pipes and bellows, (2) the exhaust system and draw-stop action, (3) the pallets and keyboard.

I. There are two distinct kinds of pipes.

(*a*) Flue pipes, either of metal or wood, in which the sound is produced by forcing the wind (or air compressed in the bellows) through a small slit, so as to impinge on a bevelled edge at the mouth (or lower end) of the pipe, in the same manner as in a common whistle; the *pitch* is determined by the *length* of the pipe.

Flue pipes may be open or stopped (at the upper end); the effect of 'stopping' a pipe being practically to double its length, and thus produce the octave below its natural note.

(*b*) Reed pipes, of metal, in which the sound is due to the vibration of a tongue of brass.

There is a contrivance for lengthening or shortening the vibrating part of this tongue or 'reed' and thus giving the proper pitch to the note.

The pipes are arranged in rows upon a windchest, the top of which consists, 1st, of a board perforated to admit the pipes; 2nd, of *moveable* slides similarly perforated so that the holes may *fit* those in the upper and *admit* the wind, or else by a slight change of position shut it all off; 3rd, another board like the first one.

Under this 3rd board are grooves running crosswise, corresponding in number to the keys of the organ, and covered underneath by 'pallets' or valves, each of which is opened by the depression of the corresponding key at the keyboard of the instrument.

The windchest is kept full of compressed air (ready to rush through any open pallet into its groove, and thence through such slides as may be drawn to admit it to the pipes) by means of the bellows.

The bellows of an organ is a huge chest with flexible sides, and moveable top heavily weighted, into which air is pumped from below. In a large organ there are often several such chests called reservoirs placed *near* to the windchests they feed, and all connected by large wooden passages.

II. In addition to the bellows for supplying the pipes, the chapel organ has an 'exhaust' bellows, *i.e.*, a chest with flexible sides and moveable *bottom* (somewhat weighted) from which the air is pumped *out*. This is to provide force for *all the mechanical* action, whether drawing slides or opening pallets. The plan in every case is to put a pair of bellows in communication with the exhaust system, when it is plain that atmospheric pressure will close its moveable side with a force proportional to its surface. The motion thus obtained can be communicated by levers to anything which requires to be moved. The particular mode of effecting this result can only be described with the help of diagrams or models.

III. Originally the pallets of an organ were moved by levers proceeding from the back of the keys. But in large organs where many pallets of great length and under heavy wind pressure are used, the weight is too great for a performer to endure. Many contrivances have more or less obviated this difficulty, the most important of which was the 'Pneumatic Lever' invented by Barker in 1833. This consisted in using a *pair of bellows* to move the levers, while the performer had only to *open a small valve* for admitting compressed air to the bellows.

It now became apparent that the small motion requisite for opening this valve could be obtained by means of an *electro-magnet*, the depression of a key producing contact and completing a current, while the raising of the key broke the current and released the armature of the magnet. The pneumatic bellows could therefore be transferred to a position *close under* the pallet, and the whole complex mass of levers and rollers done away with. Upon this grand improvement (also due to Barker) followed last of all Bryceson's new pallet, *which is itself the top board of a small pair of bellows*. The under or fixed side of this bellows has two holes alternately opened and stopped by a single piece of wood turning in a vertical plane about its middle, so that its ends rise somewhat *less* than ⅛th inch. A key being played, the magnet comes into being, the armature rises and pushes up one end of this piece of wood, *i.e. opens one* *hole* of the pallet-bellows. Now *this* hole opens into a chamber (running the whole length of the windchest), which is always kept exhausted. Hence the top of the pallet bellows is instantly depressed by 'suction,' without the intervention of any mechanism whatever! Raise the key and the magnet ceases, the wood falls and closes the hole (a spring assists this fall), but this action opens the *other* hole admitting the compressed air in the windchest, which instantly forces up the pallet home again against the grooves.

IV. Two other contrivances adopted in this organ were mentioned.

(1) The swell which consists of a large box of which one side is capable of being opened gradually like Venetian blinds, and is worked by water in a tube; the piston at one end is depressed by the use of the pedal; this causes a rod to move the blinds at the other end.

(2) The automatic action of the battery plates, which are let into the acid by the action of the exhaust bellows.

The Lecture was illustrated by large diagrams lent by Mr. Bryceson, and by an electro-magnet.

We append for permanent record the summary of *the specification* of the organ itself.

	STOPS.	PIPES.
Solo Organ	5	280
Swell	15	1008
Great	10	672
Choir	10	560
Pedal	10	300
	50	2820

This does not include couplers.

REPORT OF SECTIONS FOR 1872.

Astronomical Section.

Report on the Temple Observatory, 1872.

The instruments in use at the Observatory during the year 1872 were the Alvan Clark's Equatorial described in the first report. It has been fitted with a spectroscope giving a dispersive power of 8 prisms of 60°. During the summer Mr. Seabroke mounted a new reflector in the room adjoining the Observatory, which is furnished with a sliding roof and expanding doors. The reflector is by With, and has a clear diameter of 12¼ inches. It is fitted with roughly graduated circles and slow movements, and is provided with a driving clock, also constructed by Mr. Seabroke. The weather during the autumn was so unfavourable that little use has at present been made of the reflector. A small refractor, given by Mr. Ormerod, has also occasionally been used. The sextant and theodolite, given to the School by the late Rev. A. Grenfell, have been used for purposes of instruction. All the instruments are in good order.

The subjects of observation may be divided into three classes: double stars; the sun; and miscellaneous.

The total number of double and multiple stars measured during the year was 133, 50 of them having been measured on more than one night. It has been decided to postpone the publication of the results until further measures have been obtained. These observations have been made by Mr. Wilson and Mr. Seabroke principally, but a considerable number of observations has been made by L. Maxwell, and some by other Members of the School. The total number of measures made exceeds 1600.

The interpolating curves have been drawn for several double stars, as a preliminary to the calculation of their orbits, and in this work considerable assistance was rendered by Mr. J. B. Haslam, O.R., and by H. F. Newall and D. C. Baynes. The orbit of Castor was computed with great care, graphically and analytically, and proved to be a hyperbola, *on the data assumed*, with eccentricity 1.625. This result will need further examination, as it is at present unique. It is probable that some of the observations of last century are seriously in error.

The spectroscopic work on the sun during this year has consisted in observing and mapping down the positions of the prominences every fine day that time permitted; 32 observations only have been made on account of the cloudy nature of the weather during the summer and autumn. The object of this is to shew whether there is any particular locality more frequented by prominences and more disturbed than any other. The same thing has been done during the last few months by Mr. Lockyer, in London, in conjunction with whom the solar observations here are made. Professor Respighi and Father Secchi, at Palermo and Rome, are carrying on precisely the same research. A number of drawings of prominences and cyclones have been also made. The appearance of the vapour of magnesium and iron on the prominences was frequently noticed during the summer to a greater extent than during last year, and in the spectra of the umbra of spots the want of intense general absorption still remains, and the penumbra lacks the large amount of selective absorption seen a few years ago, showing, perhaps, a change of constitution in the photosphere, probably varying with the sun-spot period. In the summer months a comparison of the spectra of nitrogen and hydrogen at low pressure with the solar spectrum was made. About 26 lines of the nitrogen spectrum, and 50 of the hydrogen spectrum have had their positions fixed. The mode of proceeding was explained in our last report. A doubt exists as to whether the lines are really due to hydrogen, and not to some hydrocarbon, and till this is cleared up the results will be withheld. We have tried the examination of the spectra of stars, but as the apparatus has only just been completed, we have no results at present.

Mr. Crofts has taken photographs of the moon, using dry plates, probably the first time they have been used for the purpose, and, judging from the trial, it is possible that some good photographs may be obtained.

During the later months of the year a new method of observing the solar prominences has been used, which permits about 270° of the sun's limb to be seen at once, almost as in a total eclipse. This method was discovered by Mr. Seabroke, and communicated to the Royal Society on Nov. 6th, (see Appendix A). It forms a useful addition, and one previously thought to be impossible, to the methods of solar spectroscopy.

The miscellaneous work includes several drawings of solar spots made by L. Maxwell, two good drawings of Jupiter on the nights of Jan. 6 and March 8; and occasional observations on Saturn, the moon, and some nebulæ. An aurora was examined with the spectroscope on Feb. 4 while rain was falling. It gave a line near D, very bright, a line near it in the green, and diffused light over the green. No red line was seen. Meteors were occasionally observed, specially on the nights of Nov. 25 and Nov. 27 (see Appendix B). On the first of these nights a radiant in N. Decl. 45° R. A. 23^h 20^m was indicated; and on the second one in N. Decl. 48° R. A. 0^h 48^m.

Venus was not favourably situated for observation during the year; she is now an evening star, and it may be remarked that she again shews the same brilliant area round the northern cusp that attracted our attention in 1871.

The following presents to the Observatory have been made during the year.

By the Rev. C. Darnell—

Account of the great comet of 1858, by G. P. Bond, in one vol., 4to., with 51 plates.

By Mr. Wilson—

Memoirs of the R.A. Society. Vols. xxxvii., xxxviii., and xxxix., part 1.

General index to the first 38 vols. of the Memoirs.

Index to the first 29 vols. of the Monthly Notices, 1827—1869.

The number of visitors to the Observatory was 236.

During the Lent Term a course of lectures on Astronomy was given by Mr. Wilson and Mr. Seabroke. They were attended by about 50, of whom about one-quarter were members of the School. Eighteen passed an examination at the end of the Term, most of them, both boys and girls, with great credit.

[*Read Feb.* 1873.]

APPENDIX A.

"*On a New Method of Viewing the Chromosphere.*" *By J. N. Lockyer, F.R.S., and G. M. Seabroke. Received, November 6th,* 1872.

The observations made by slitless spectroscopes during the eclipse of Dec. 11, 1871, led one of us early this year to the conclusion that the most convenient and labour-saving contrivance for the daily observation of the chromosphere would be to photograph daily the image of a ring slit which should be coincident with an image of the chromosphere itself.

The same idea has since occurred to the other of us. We therefore beg leave to send in a joint communication to the Royal Society on the subject, shewing the manner in which this kind of observation can be carried out, remarking that although the method still requires some incidental details which will make its working more perfect, images of the chromosphere almost in its entirety have already been seen on several days during the present month and the latter part of last month.

The adaptation of this method to a telespectroscope will be seen at a glance from the accompanying drawing.

The image of the sun is focused on a diaphragm having a circular disk of brass (in the centre) of the same size as the sun's image, so that the sun's light is obstructed and the chromosphere light is allowed to pass. The chromosphere is afterwards brought to a focus again at the position usually occupied by the slit of the spectroscope, and in the eyepiece is seen the chromosphere in circles corresponding to the C or other lines. The lens D is used to reduce the size of the sun's image and keep it of the same size as the diaphragm at different times of the year, and the lenses F are used in order to reduce the size of the annulus of light to about ⅛th of an inch, so that the pencils of light from either side of the annulus may not be too divergent to pass through the prisms at the same time, and that the whole annulus may be seen at once. There are mechanical difficulties in producing a perfect annulus of the required size, so one ½-inch diameter is used and can be reduced virtually to any size at pleasure.

The proposed photographic arrangements are as follows.

A large Steinheil spectroscope is used, its usual slit being replaced by the ring one.

A solar beam is thrown along the axis of the collimator by a heliostat, and the sun's image is focused on the ring slit by a 3¾-inch object glass, the solar image being made to fit the slit by a suitable lens.

By this method the image of the chromosphere received on the photographic plate can be obtained of a convenient size, as a telescope of any dimensions may be used for focusing the parallel beam which passes through the prisms on to the plate.

The size of the image of the chromosphere obtained by the method adopted will be seen from the accompanying photograph taken when the ring slit was illuminated with the vapours of copper and cadmium.

APPENDIX B.

Report on "Falling Stars" by L. Maxwell.

On the 27th November, between sunset and 7.30 P.M., a brilliant display of meteors was seen; so bright, indeed, as to attract general attention even from those who take the least interest in such matters. The meteors appeared to radiate from a point in the sky situated somewhere between Cassiopeia and Andromeda, near the star π of the former constellation, which at the time was nearly due south-east and not far from the zenith. The meteors at times were very numerous; no exact estimate of their numbers can be made, but perhaps they averaged about 30 per minute. They were visible for about a second or two, and had moderately long trains.

These are not the true "November meteors," as usually so called, which are the remains of comet I., 1866, called Tempel's comet, but are most probably the remains of Biela's comet, a short-period comet of 6 years and 9 months. This comet distinguished itself at its last appearance in 1846 by dividing into two independent parts, which reappeared in 1852, and have not since been seen: this comet at its perihelion is distant about 82,000,000 miles from the sun, and at its aphelion about 585,000,000 miles; its orbit actually cuts the earth's orbit at the point we occupy on the 30th November. The last time Biela's comet was due was in January, 1866, just 6¾ years ago, but it was never seen, and no cause could be assigned for its disappearance: it seems, however, to have returned on this occasion, and it was doubtless owing to our passing through the path of this comet (the 2 days earlier is owing to the retrogression of the nodes of the planet's orbit on that of the earth) on the 27th November that we witnessed this beautiful display of falling stars.

Exact position of the radiant area as determined by Mr. Wilson and Mr. Seabroke:

N. D. 47° R. A. 11°
Celestial Latitude 37° Longitude 32°

giving a point between ϖ Cassiopeiae and φ Andromedae, extending a good way south of this point, and somewhat east also.

Meteorological Section.

There is nothing special to remark in connection with the meteorological observations of the last twelve months. The afternoon reading of the barometer has been given up, in consequence of the difficulty of having it taken at the same hour at different times of the year. The other observations have been taken as before.

The names of those who have assisted in the observations are given below.

J. Armitage
H. H. Barnet
D. C. Baynes
A. S. Dixon
A. S. Forbes
F. A. Frost
H. B. Hemming
H. N. Hutchinson
G. L. King
W. B. Lowe
L. Maxwell
A. W. Moore
F. R. Owen
P. R. Page Henderson
A. B. Pearson
G. M. Seabroke (O.R.)
B. R. Wise
E. T. Wise

For the holidays, Mr. F. Kirk and Mr. Wheeler.

T. N. HUTCHINSON.

The readings were taken at 8.30 a.m., except during the first 6 weeks of the year, and the last 4 weeks. The readings were reduced, and the averages computed by Mr. Wilson with the assistance of some of the observers.

Meteorological Observations.

January.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	29,715	38,6	36	44,6	33,8	,16	18	28,975	41	38,2	50	40	,05
2	29,787	39	38,8	43,2	38	,09	19	29,317	35	34	45	33,2	,01
3	29,885	35	34	46	33	,22	20	29,612	34,6	34,2	45	33,8	,04
4	29,345	41,4	38,2	45	34	,16	21	29,751	32,4	32,4	37	30	,01
5	28,937	42	39	51	40	,10	22	29,606	36,6	36	38	32	,32
6	29,530	37	35,2	48	34	,06	23	28,910	43	42	44	36	,67
7	29,549	35,2	35	41,2	33,8	,25	24	28,478	35	35	45	33	,09
8	29,283	32,4	32	42,6	30	,08	25	28,922	43,6	42	47	34,6	,19
9	29,548	33	32,4	41	32	,01	26	29,284	40	40	48	38,8	,02
10	30,121	32	31,8	39	31	,18	27	29,846	40,2	40	44,8	39,8	,01
11	29,784	39,6	39,2	44,4	32	,01	28	30,032	39	39	43,6	37	
12	30,155	35	34,2	50	31	,01	29	29,938	43,5	43,2	44	36	,17
13	29,918	46,8	46,2	47	39,2	,21	30	29,667	49	48,6	50	43	,03
14	29,830	40	39	51	38		31	29,839	46,8	45,2	49,8	44	,02
15	30,037	30,4	29,8	48,6	27	,10	Average						Total
16	29,946	34,2	34,2	41,2	30	,21		29,583	38,6				3,84
17	29,542	44,8	43,8	44,8	33,4	,36							

February.

1	29,612	45,8	44,2	52	42	,07	17	29,794	35	34	43	33	,14
2	29,587	45,5	44,5	50,2	42,8	,02	18	29,677	42,5	41,5	50,8	36,8	,79
3	29,938	41	41	51	35,5	,01	19	29,686	42	41,5	44	34	,01
4	29,811	42,8	42	46,2	40,5	,02	20	29,853	42	41,5	49	34,2	,02
5	29,608	44,8	42	48,5	41,2	,29	21	29,791	38	37	49	35	
6	29,687	45,8	44,8	48,5	43,8	,04	22	30,103	40,5	39,5	53	35	,30
7	29,924	40	39,2	50	40	,11	23	29,783	43,5	43	41,8	40	,01
8	29,941	43	43	53	40	,01	24	29,533	44	43	50	39	,14
9	29,934	37	37	51,2	35	,03	25	29,474	46,5	46	53	39	
10	29,903	46,8	45	50	36,5		26	29,577	40,5	40,2	54,8	39	,04
11	29,840	43,8	43	55	43	,01	27	30,188	36	34,2	46	34	
12	29,666	39,5	38,5	48	39	,05	28	30,153	37	34	43,15	34	,01
13	29,776	42,5	42	49,8	39	,02	29	29,720	47,5	46	47,8	36	,08
14	29,766	41,8	41,8	52	41		Average						Total
15	29,715	40,5	40,5	41,5	38,5			29,782	42°,3				2,27
16	29,776	41	39,5	42	35	,03							

March.

1	29,706	48,2	47,8	52,1	47	,015	18	29,865	43	40,8	54,2	37,2	
2	30,137	38,1	38,4	55	36,2	,005	19	29,949	42,6	40,2	51,2	40	
3	30,065	48	47,2	54,2	38,2		20	30,061	36,8	34,2	45,4	31	
4	30,221	43,2	43	52,2	42,4		21	29,640	30,2	30	40,6	27	,03
5	30,052	47,5	44	58,8	43		22	29,824	31,4	31,2	38	28	,01
6	29,933	45,4	42,6	58,8	40,2		23	29,908	33	32	37,2	29,6	,185
7	29,500	43,4	42,2	59,4	37	,006	24	29,734	33	33	44,4	28	
8	29,472	48,8	47,2	59,4	43,2		25	29,630	33	31	42,5	29,8	
9	29,878	47,4	41	52,2	40,1		26	29,542	33	30,1	42,1	26	,375
10	30,304	40,8	37,4	51	29,2		27	29,640	35,8	34	46,3	29,8	
11	30,285	39,6	38	51,8	33		28	29,360	50,6	49	52,6	35,2	
12	30,102	41,4	40,7	54,4	38,8		29	29,424	52,6	50,5	55,1	49,6	,278
13	29,985	39,8	39	52,6	34,2		30	29,352	50,9	50	55,4	47,3	
14	29,529	42	40,8	56	39,2		31	29,487	47,1	46,1	55,8	46	,18
15	29.704	41,2	40,6	48,2	36,4		Average						Total
16	29,922	47,6	46	58	41			29,813	42,1				1,154
17	30,045	49,6	48	60,6	39,2	,07							

April.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	29,501	no	obser	vatio	ns	,50	18	29,851	43,8	40	52	37	,03
2	29,407	48	48	54	43	,30	19	29,963	40	37	49	34,8	
3	29,697	44,5	43	48	35		20	29,559	42	39	50	29	
4	29,928	42	43	47,5	34	,06	21	29,059	35,4	34,6	52	32,6	,49
5	30,350	47	44	47	31		22	29,269	47	44	48	33	,21
6	30,503	43	40,2	50	37		23	29,277	50,2	47	53,8	34	,05
7	30,451	49	45,2	49	32,4	,02	24	29,497	48	44,6	56	41	,02
8	30,050	53,8	51,8	56,4	48		25	29,750	51	46	56,2	40,4	
9	30,287	46,2	42	61	38,4		26	29,836	53,6	48	58	43,6	,05
10	30,217	50	46	58	36,2		27	29,791	58	54	58,8	41	,69
11	30,084	53	48	64	45		28	29,864	46,8	46	63	45,6	,03
12	29,778	58,6	51	65	44,4		29	30,365	56,8	49,8	56	38	
13	30,219	50	45	70	38,2		30	30,464	56,2	49,2	63,2	39,2	
14	30,289	49,6	45,2	62	36,4								Total
15	30,164	47	46,8	61	38		Average	29,914	44,17				2,51
16	30,101	47,6	43,2	67	40,2	,01							
17	29,842	44,8	39,8	53	37,4	,05							

May.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	30,381	56	53	65,2	46,2		18	29,668	40,5	39,4	49,4	38,4	,07
2	30,246	60	54	69,2	45		19	29,773	47,8	41,5	48,5	29,5	,02
3	30,160	51,8	49,2	71,2	42	,01	20	29,836	48	43,5	52	32,1	,01
4	29,597	50,6	45	59,2	45,6	,05	21	29,793	47,7	44,6	57,8	40	
5	29,574	52	47,6	53,8	45,8	,07	22	29,873	51	46,7	59,2	38,6	,01
6	29,616	46,6	43,8	61,6	41,5	,18	23	29,906	49	44,8	61	36,6	,18
7	29,382	47,4	45,8	51,2	42,8	,18	24	30,033	50,8	46,5	58	35,2	
8	29,398	45,7	42,9	55	40,6	,41	25	30,219	52,7	48	63	36,5	
9	29,730	43,8	43,4	53,1	42,4	,10	26	30,434	52	51	61,6	50,2	
10	30,138	46,9	44,1	49,7	38,6	,05	27	30,385	56,7	53,5	59,8	43,3	
11	30,211	39,8	37,4	52,2	34,1	,18	28	30,320	57,6	53,9	68	52,2	
12	29,960	42,7	42	48,6	38		29	30,133	55,9	53,5	68	45,1	
13	29,900	47,4	45,1	55,2	42	,18	30	30,042	57,9	53	66,8	50,1	
14	29,856	49,3	46,7	49,4	49,1		31	29,991	52,9	49	65	44,1	,09
15	29,883	50	48,2	50,8	49	,34							Total
16	29,809	47,4	47	67,8	45,2	,05	Average	29,635	49,83				2,18
17	29,709	46,9	45	59	46,5								

June.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	30,154	51,5	47	51,5	38	,48	18	30,015	71	66,5	77,5	65	,76
2	29,811	51,0	50,5	63,5	41	,07	19	29,835	67	62	81,5	57	,29
3	29,828	56,5	51,5	62,5	44,5	,08	20	29,987	59,5	56,8	79,5	56,5	
4	29,960	49,5	47	58,5	47		21	30,031	64	55	64	47	
5	30,131	53,2	53	62	41	,04	22	29,994	57	55	64	47	
6	29,889	55	53	65	60,5	,69	23	30,104	60	58	66	47	
7	29,718	50,5	42	57,5	37,5	,14	24	29,901	61,5	59	70	52,5	,02
8	29,693	51,5	48,2	58,5	42	,25	25	29,612	62,5	60,5	76,5	56,5	,31
9	29,416	53	49,5	58,2	43,5	,20	26	29,820	58	57	66,5	51	,16
10	29,474	48,5	47	58,7	46	,05	27	29,990	58	56	63,5	49	,10
11	29,665	55	51,2	59	47	,45	28	29,764	58,5	58	64,5	54	,01
12	29,843	57,5	51	58	43		29	29,946	56,2	53,5	68	46	
13	29,902	60,5	56,5	62,5	51		30	29,984	62	59	67	43	,20
14	30,068	62	59,5	62,5	46								Total
15	30,139	65	60	73,5	50,5		Average	29,882	58,3				4,30
16	30,289	67		76	56								
17	30,221	70	65	77	55								

July.

Date	Barom. Reduced	Temperature				Rain	Date	Barom. Reduced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.	Inches			Dry Bulb	Wet Bulb	Max.	Min.	Inches
1	29,815	55,2	55	72,2	55	,09	18	29,973	61,5	60,2	68	51	,01
2	29,961	59,8	59	69,5	52,6		19	30,080	58,8	58,2	74	54,2	
3	30,201	58,8	58,1	72,4	46,8		20	30,102	60,8	60,6	72,2	53,2	
4	30,233	62,5	61,9	72,5	49,2		21	30,059	71,2	71	77,2	59	
5	30,150	68,5	68	78,8	56,8		22	29,856	72	71,4	83,6	58	
6	29,999	66,3	66	80,6	56,2	,94	23	29,879	63,2	62,2	81,5	55	
7	29,809	63,5	63	80,8	57	,21	24	29,903	68,5	67	80,3	60	,01
8	29,742	57,1	57	75,5	56,3	,17	25	29,920	66	65,5	78	63	
9	29,728	57,8	57,1	63,6	54,4	,06	26	29,804	73,2	73	83,2	64	,95
10	29,926	59,8	57,2	71	45,2	,18	27	29,979	68,4	68	78	57	,13
11	29,856	61,5	61	71,1	56	,31	28	30,014	67	67	77,8	55	
12	29,931	61	60,9	71,3	60		29	29,810	68	68	76	58	
13	29,857	61	59,6	70,8	51,2	,50	30	29,733	59	59	74	58	,53
14	29,928	60,2	58,2	63,2	49,8	,19	31	29,972	58	58	61	43	,06
15	29,944	54,2	54	65	53								
16	29,956	54,8	54,3	61,8	46		Average	29,936	62,3	61,7	73,5	54,4	Total 4,34
17	29,936	55,8	55,2	74	53								

August.

Date	Barom. Reduced	Temperature				Rain	Date	Barom. Reduced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.	Inches			Dry Bulb	Wet Bulb	Max.	Min.	Inches
1	29,838	58,6	58	65,4	49,6		18	30,190	68	63	79,2	51	
2		56	54,8	70,2	52,8	0,15	19	30,253	60	56	82	52	
3	29,761	56,2	53	67	49,4		20	30,159	65	60,2	77,4	52	
4	29,878	50,4	49,8	63	48	0,01	21	29,959	65	62,4	74,2	57,8	
5	29,670	55	53	68	50	0,01	22	30,051	62,4	60	76	58	
6	29,673	60	56	60,2	52,8	0,17	23	30,169	59	55,8	74	53	
7	29,537	59	57	69,2	51	0,05	24	30,253	60	56,8	72	47	
8	29,781	58	57	67	58	1,28	25	30,118	63	60,4	76	57	
9	30,048	54,2	54	67	50	0,13	26	29,757	61,2	57,8	73,2	55	0,44
10	29,667	61	57	67	54	0,11	27	30,157	56	51	64	48,6	0,39
11	29,669	58,2	53	64,8	53,8	0,15	28	30,285	56	53	62,2	44	
12	30,037	58	53	63,2	53	0,05	29	30,057	60	55,6	69,8	50,6	
13	30,171	56	53	63,6	45		30	29,838	56	55	65	54	0,01
14	30,245	57	55	68,4	45,8		31	29,744	57	53	62	49,8	0,04
15	30,265	59	56	73,2	49,4								
16	30,169	58	55,8	68	52		Average	29,942	59,3	55,9	69	54,3	Total 2,99
17	30,133	65,2	61	67	51,2								

September.

Date	Barom. Reduced	Temperature				Rain	Date	Barom. Reduced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.	Inches			Dry Bulb	Wet Bulb	Max.	Min.	Inches
1	29,934	58	54	68,4	46	,33	18	29,566	57,6	52,2	68,4	51,8	,01
2	29,881	62,8	60	62,8	53		19	29,552	52,8	49	61,2	45	
3	29,724	67	62	74	58	,04	20	29,815	44,6	42,8	62	39	
4	29,631	67,8	64	75,4	60	,02	21	29,776	47	44	54,6	38,8	,10
5	29,763	64	60	75	58		22	29,880	47,8	42	52,8	35	
6	29,769	60	57	70,2	54,8	,10	23	29,840	47,4	44,6	55	35	,13
7	29,759	60	58	67	55	,07	24	29,424	47	45	53,8	44	,01
8	29,974	61	56	64	49	,01	25	29,515	45	42	49,2	37,4	,09
9	29,870	57	56	66,4	55	,15	26	29,912	47	45	51	44	,14
10	29,865	59	55	61	50,2	,02	27	29,815	55	53,8	55,2	42	,33
11	29,941	66,4	63	67,2	56		28	29,549	53,6	50,8	60	49,6	
12	30,053	64,8	61	71,8	59		29	29,724	56	51	61	45	,03
13	30,337	64	61,8	72,4	58	0,01	30	29,918	49,8	48	60,2	45,8	,01
14	30,153	61,8	60,2	74	58								
15	30,041	62	59	66	53		Average	29,830	57	53,4	63,6	49	Total 1,61
16	30,089	54,6	52	67	48,8	,01							
17	29,856	59	55	62,2	51,6								

October.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	29,773	no	obser	vatio	ns		18	29,715	49,5	49	50,5	39	,36
2	29,372	57,2	56,5	61,5	49	,09	19	29,759	49,5	49	53	40,5	,06
3	29,364	52,2	51	63	48	,04	20	29,735	48	47,5	51,5	41	,67
4	29,780	39,5	38	59	32	,05	21	29,526	47,5	47,2	52	42,5	
5	30,256	43	41,2	49	40	,04	22	29,460	48,5	48,2	49	47	
6	30,833	41,5	40,5	49,5	37,5	,004	23	29,770	36,5	36	50,5	33,2	
7	30,221	47	45	59	40	,06	24	29,327	47	45	53,5	36	,25
8	30,021	51,5	51	55	46	,09	25	29,237	46,5	45	49	42	,015
9	29,751	47,5	47	64	43	,45	26	29,291	46,5	46	54	43	,015
10	29,700	43,5	42	51,5	36	,22	27	29,597	49	47	54	45	,01
11	29,407	43	41	53	40,5	,003	28	29,758	44	43,5	57	42,5	,005
12	29,637	37,5	37	58	34	,01	29	30,024	46,5	46	55	39	,15
13	29,792	41,5	40	49	33	,002	30	29,596	45,5	45	55,5	43	,245
14	30,067	31,5	30,5	51	27		31	29,620	48,5	47	55	45	,006
15	29,907	36	35,5	56	37	,03							Total
16	29,330	43,5	43	47,5	35	,06	Average	29,695	45,20				3,025
17	29,680	37,2	37	47	32,5	,09							

November.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	29,713	45	43,5	51	41	,10	18	29,569	34,5	33,5	40	33	,75
2	29,376	44,5	42	55	42	,3	19	29,492	34	34	38	32,5	,13
3	29,713	42	41,5	51	39		20	29,392	42,5	41	45	33	,01
4	30,055	42	40,5	50,5	38	,29	21	29,635	44	43	45	43	,15
5	29,684	56,5	55,5	57	41	,02	22	29,496	48	48	52	45	,86
6	29,792	57	55	61	48		23	29,027	52	57	56	40	,02
7	30,152	48	45	59	45		24	29,277	47	45,5	55	45	,04
8	30,254	48	46,5	56,5	42,5		25	29,338	45	44	55	38	,30
9	30,165	40,5	40	56,5	38	,16	26	29,284	49	46	53	40	,65
10	29,732	39	33	51	35	,01	27	29,543	49	46	52	46	,01
11	29,992	33,5	32,5	41	32	,01	28	29,706	42	41	51	40	,06
12	30,076	38	37	41,5	38	,19	29	29,493	39	38	48	38	,18
13	30,195	34,5	33	45	39	,05	30	29,026	42	41	48,5	38	,40
14	29,822	37	36	45	29	,05							Total
15	30,087	36	35	42	30		Average	29,667	42,8				4,74
16	29,602	37,7	37	47	35								
17	29,726	37	36	39	35								

December.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1	28,907	42	41	46,5	41	,04	18	29,644	47,5	47	48	36	,15
2	29,612	38,2	37,5	40,5	34	,02	19	29,657	35,5	35	40,5	32,5	,26
3	29,554	41,5	41	45	37,5		20	29,685	38,6	38	38,8	35	,17
4	29,847	36	34	44,5	34		21	29,458	44	43,6	44	38	,08
5	30,014	26,5	29	39	25,5	,25	22	29,898	43,8	43,6	46,8	40	,02
6	29,427	40,5	39	44	26		23	29,646	44,6	45,8	51,6	43	,01
7	29,421	36,5	35,5	48	35	,06	24	29,347	45	44	52	43	
8	29,507	38	35,5	43	34,5		25		48,6	46,2	49	45	,03
9	28,993	37,5	36	46	36	,02	26		46	45	50,4	44,8	
10	29,091	34,5	34	43	34		27		47	45	50	41	
11	29,445	36	34,5	46	33		28	29,599	48	46	49	46	,18
12	30,012	25	26	34	24,5		29		46,2	46	48,2	44	0,07
13	29,766	34,5	34	35	31	,08	30	29,919	42,6	42	51	42	0,02
14	29,562	33	33	38	30	,5	31	29,655	44,6	43,8	49,6	36	0,11
15	29,805	39	38	40	33								Total
16	29,884	32	32	37,5	31,5	,85	Average	29,579					3,30
17	29,284	42,5	41	44	33	,38							

The rainfall in 1872 was remarkably large, and it may be well to compare it with the average rainfall at Rugby of the last 18 years.

	Average fall per month.	Fall in 1872.	Difference.
January	2.01	3.84	+ 1.83
February	1.41	2.27	+ .86
March	1.63	1.15	— .48
April	1.56	2.51	+ .95
May	1.71	2.18	+ .47
June	2.39	4.30	+ 1.91
July	2.38	4.34	+ 1.96
August	2.39	2.99	+ .60
September	2.50	1.61	— .89
October	2.46	3.02	+ .56
November	1.68	4.74	+ 3.06
December	1.76	3.30	+ 1.54
Yearly Total	23.88	36.25	12.37

Zoological Section.

Dates for 1872.

February 22nd. Rook's nest begun in Close. J. G. Adamson.

February 5th. Linnet, Thrush, House-sparrow, and Hedge-sparrow's nests begun. B. R. Wise.

March 3rd. Jackdaws building in elm tree in Close. B. R. Wise.

March 16th. Wood Pigeon's with eggs, Robin's with young, Blackbird's with eggs, Thrush's with eggs (hard set). W. C. Berkley.

March 20th. Missel Thrush's with eggs.

March 30th. Peewit's eggs taken near Newton, were in Page's window.

April 28th. Moorhen's nest with four eggs, Corncrake heard at Cross Roads, Starling's nest with four eggs. A. G. Burchardt, C. M. Chadwick.

May 1st. Kestril Hawk's with four eggs (hard set). A. G. Burchardt, C. M. Chadwick.

May 2nd. Magpie's with two young birds nearly fledged. A. G. Burchardt, C. M. Chadwick.

May 13th. Whitethroat's nest with two eggs. J. G. Adamson.

May 19th. Sandmartens observed building at the Sand-pits, Hillmorton. J. G. Adamson.

May 16th. Swifts building on Sanatorium.

The total number of Rook's nests in the Close as near as could be reckoned was 97.

Observations have been made throughout the year by Mr. Hutchinson on the habits of the Hippocampus. His paper is here subjoined.

J. G. ADAMSON.

On the " Hippocampus brevirostris " by Rev. T. N. Hutchinson.

At the beginning of last October, (1872), I purchased two of the curious little creatures popularly known as " Sea Horses" (Hippocampus brevirostris, *Cuvier*), from Mr. George King, of Great Portland Street. (Exhibited to the Society on the evening of November 2nd, 1872.) They performed the journey in a pickle bottle filled to the top with sea water, and upon being transferred to larger and more commodious quarters in an aquarium, they appeared to be none the worse for their shake in the train.

After two or theee days, however, they began to look decidedly seedy; all their liveliness was gone, and they were evidently, in plain English, very hungry. I had been assured that they would live very well on the minute organisms to be found in the sea weed which was placed at the bottom of the aquarium, but it was plain that they thought differently, and required food of a more substantial nature. I wrote to Mr. King, and was consoled by the information that they would thrive on " small shrimps;" very small indeed they would have to be, as their tubular mouth does not open more than about the $\frac{1}{16}$th of an inch, to say nothing of the difficulty of getting such small ware in the centre of England. Mr. King kindly hinted in a P.S. that failing shrimps, sand hoppers (*gammari*) had been used successfully at the Brighton Aquarium; but this was not much help. I then wrote to Mr. W. A. Lloyd, of the Crystal Palace Aquarium, but it appeared that the attempt to keep the Hippocampi in the splendid tanks at Sydenham had failed from the very conditions that insured success with all the other creatures—the powerful current constantly flowing through the tanks, while it keeps the water perfectly free from pollution, carries off any minute creatures which would serve as food for the Hippocampi.* Mr. Lloyd however was good enough to refer me to the Rev. A. Johnson, of S. Olave's Grammar School, Southwark, who had succeeded in keeping Hippocampi alive for several months by feeding them on the milky juice that flows from an oyster when the shell is opened. This plan I at once adopted, and, so far, with entire success. I have now had my two little marine steeds in captivity for more than four months†, and judging from the gambols which I saw them performing this morning while sketching their likenesses (shewn in figs. 1, 2, 3, 4, plate IV.), they do not appear to be pining much for their liberty.

---

* Since the above was written, the Hippocampi have been again introduced at Sydenham, and this time with perfect success.

† May 19th. They are still in excellent condition, after nearly eight months captivity.

T. N. H.

Plate IV.

Fig 1

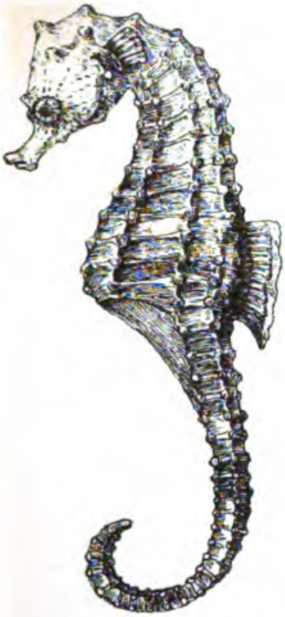
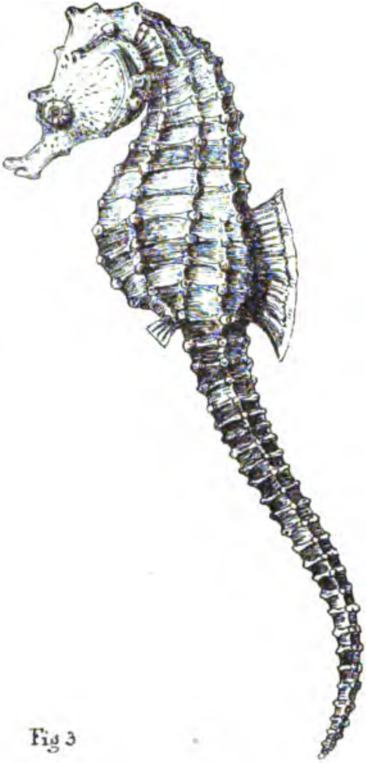


Fig 2



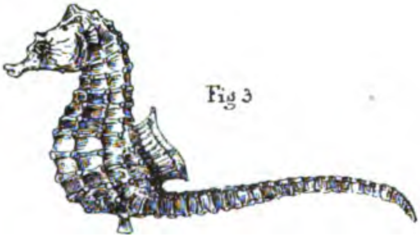


Fig 3

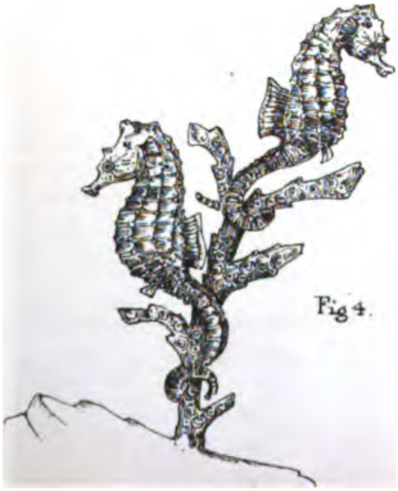


Fig 4.

As it is possible that some others may attempt to keep Sea Horses, I will explain precisely how I carry out Mr. Johnson's plan. Before feeding I transfer the little creatures to a smaller vessel, about the size of an ordinary finger glass, filled with sea water. The oyster after being opened is held over the water and the milky juice drops into it. The Hippocampi seize it voraciously, striking their beaks against the glass with quite a sharp sound in their eagerness; now and then they will take in minute bits of the oyster itself, but it is chiefly the milky liquid that they prefer. In about half-an-hour they seem to be satisfied, and I then replace them in their tank.

The reason for using a separate vessel is obvious. The whole of the water in the tank would be rendered turbid for some time if the juice were allowed to fall into it. The small amount of water in the finger glass is of course made turbid, but by syringing it for a few minutes each day, with two or three pieces of charcoal in it, the organic matter is oxidised, and the water becomes perfectly clear by the time it is next wanted. As a rule I find once a week sufficient for a feast, but occasionally they are indulged with two meals in the seven days.

I ought to add that Mr. E. Edwards, of the Menai Straits, has succeeded in keeping Hippocampi for several months by simply supplying the tank with abundance of the sea-weed known as *Griffithsia setacea.* He has found by experience that this particular sea-weed harbours an unusual quantity of small crustacea and other minute creatures, upon which the Hippocampi can feed.

And now for some account of the animals themselves.

Peculiar as their appearance is, they are true fishes, belonging to the family of the *syngnathidæ* (united-jaws) included in the order *lophobranchii*, so called from the fact that the gills are disposed in pairs of small round tufts. The only British species belonging to this order are, in fact, the Hippocampus, and the true *syngnathus*, or pipe fish, a slender snake-like fish, of which several varieties have been found on our coasts, the jaws in each case being united into a tube.

The technical description I will give from Yarrell. "The whole length from the point of the nose to the end of the tail is about five inches: the connected jaws, forming a tubular mouth, are considerably shorter than the rest of the head: the eyes prominent, the irides straw yellow; over each eye a single prominent spinous tubercle: the operculum covered with striæ radiating from the front: the pectoral fins, placed immediately behind the operculum, are small, apparently containing about eight rays in each: the form of the body heptangular, three angles on each side, the seventh longitudinal angular line being on the abdomen; the back flat; the transverse sections of the body eleven, with tubercular projections at the points of intersection; the rays of the dorsal fin about sixteen: the anal fin is peculiar to the female only, and probably performs some office at the time of the transfer of the ova to the pouch of the male:

this anal fin contains four rays: the abdomen as deep again as the tail: from the vent the form of the tail is quadrangular, ending in a point; the number of segments about thirty: the general colour is a pale ash brown relieved by a changeable iridescence, and variable tints of blue dispersed over different parts of the head, body, and tail."

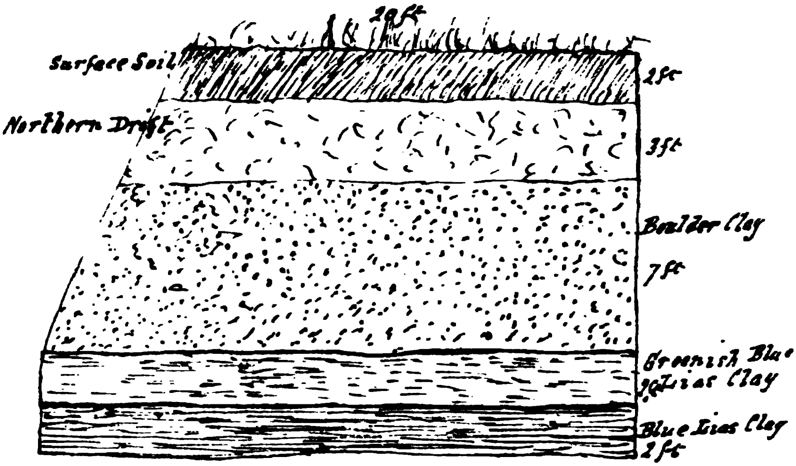
In my own specimens I do not observe these blue tints, and the colour of the eye is rather orange red than "straw yellow." The eye is one of the most striking features about them, and is singularly beautiful, both from its metallic brilliancy and the varied movements of which it is capable. They possess the power of winking to perfection, as the eyes move quite independently of each other, a peculiarity said to belong to the chameleon. The dorsal fin is edged with a frill of a very delicate yellow colour. The rapid corkscrew-like motion of this fin when the creature is swimming is perfectly marvellous to behold.

Fig. 1, Plate IV. represents the male, fig. 2 the female, both the size of life. Their general appearance is much the same, but the female is distinguished by the small anal fin at the base of the abdomen, while the male has a curious pouch of thin skin or membrance in which he carries the ova of the female till they are hatched. The male is rather smaller than the female, and the dorsal fin is shorter. Fig. 2 shews the general position of the Hippocampus when swimming: sometimes, however, I have seen them swimming in a nearly horizontal position, as in fig. 3. In fig. 4 I have shewn my two animals in one of their favourite attitudes, with their tails coiled round the branches of a piece of coral. They only seem happy when, after swimming or any exertion, they can repose by twisting their tails round something—sticks, straws, bits of sea-weed, &c. They are easily tired, and it is amusing sometimes to see them after swimming round their tank a few times, fairly lie down on their sides on their bed of sea-weed.

Their most vigorous exercise consists in rolling over on their backs upon the sea-weed, precisely in the way in which a donkey luxuriates in a dusty road. The resemblance is quite grotesque. My Hippos do not often appear to be up to the mark for this exercise, but I have noticed that they are most inclined to gambol in this way upon placing the aquarium in the sunshine. Occasionally they have a kind of wrestling match, twisting their tails round each other and pulling vigorously in opposite directions till the weaker is obliged to give way.

I will only add, in conclusion, that my two specimens came from Marseilles, that the Hippocampus is occasionally found on our own coasts, more frequently off the coasts of the Channel Islands, and also in tropical seas, where, however, it attains a much larger size. It appears to have been seldom kept for long in captivity, on account of the difficulty of providing suitable food. Yarrell mentions one gentleman who had kept two living Hippocampi "in a glass vessel for twelve days;" he also states that "a specimen was once shewn at Southampton which lived more than a fortnight in a glass globe," and he "had heard of one that lived three

PLATE. V.



Section at Rugby Pit. March 1872

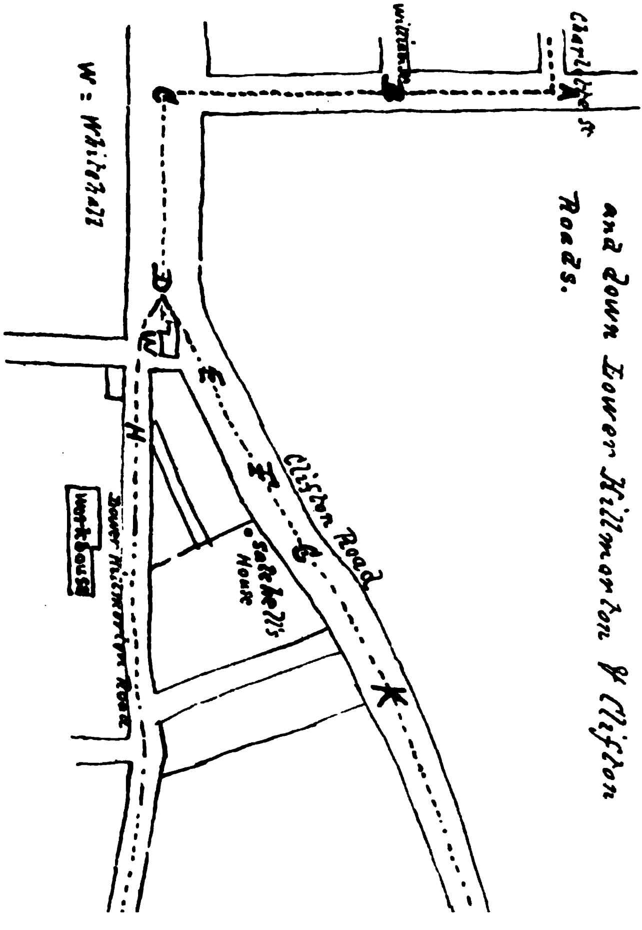


Diagram shewing drain up Pigstye Lane and down Lower Hillmorton & Clifton Roads.

------ denote the course of the drain

weeks in confinement at Harwich, the undulating motion of which when swimming was performed with great ease, and was very interesting to observe."

Anatomical Work.

Work in this branch was only started last year, and therefore great results cannot be fairly expected of it as yet; nevertheless, owing to the active work of our late member, A. G. Burchardt, we were able to place in our cabinet several specimens, which though not of any intrinsic value, may prove of some assistance to those studying this branch of science.

The following is a list of specimens.

Skeleton of a Cat, found in old chapel underneath the boards.

Skulls of Weasel, Hedgehog, Mole, Mouse, Stoat, Brown Rat, Water Rat, Sparrow. Pig's skull divided to show interior.

Skins of Field Mouse, Common Mouse, Long-tailed Field Mouse, Common Shrew.

There were ten old specimens in spirits which were rebottled, and to them were added,

Body of Frog, to display position of muscles.

Fresh-water Crawfish.

Newt, shewing interior arrangement.

Sea Mouse.

Six-spiked Stickleback, and two-spiked one.

Six bottles illustrating transformation from Tadpole to Frog.

C. M. CHADWICK.

Geological Section.

Two specimens of the excessively rare Discina Holdeni, the small Liassic brachiopod, were found by Mr. Neilson in the Upper Hillmorton Clay Pits, adhering to a portion of Ammonites armatus. This is a new locality for this fossil, which has only once before been found in this neighbourhood, (at Newbold, by E. Cleminshaw), and has very rarely been found anywhere.

In gravel close to the Watling Street Road at Caves Inn, a right metatarsus or shin-bone of horse has been found: also in a brook that passes the same road between Clifton and Hillmorton, a portion of the left scapula shewing cotyloid cavity.

In a brook near Newton, Os femoris, Os humeri, and Cervical vertebrǎ: also in the bank of the Avon, near Little Lawford Mill, a glass bottle, date about 1700, (according to Mr. M. Bloxam), shewing corrosion by the action of water, have been found by E. Wise and W. B. Lowe.*

---

* This confirms the view expressed in a former report that these alluvial deposits, which are very rich in bones, are very recent. J. M. W.

The following section (Plate v.), is of Rugby Pit, (taken March 16, 1872), situated nearest the brick kilns: in this section we have two feet of surface soil, resting upon about three feet of the (so-called) Northern Drift, and then seven feet of Boulder Clay, containing striated chalk pebbles, flints, etc., and under this two feet of greenish blue clay, and then Blue Lias Clay to some depth.

In Toft Clay Pits there have been found some very pure crystals of sulphate of Calcium, (selenite), with lamellar fracture, containing traces of iron and magnesium: also Gryphæa incurva, and Ammonites Bucklandi, (both new to the pit).

The Lower Hillmorton Clay Pits contain a few fossils, but none of importance.

In Upper Hillmorton Pit, fossils of any size continue to be scarce; a vertebra of Icthyosaurus has however been found.

Newbold Lime Works have yielded vertebræ of Icthyosaurus, Rhynconella variabilis, Lignite, Lima gigantea, Gryphæa cymbium, and part of a crustacean.

New Bilton Clay Pits have been worked very little this year.

In New Bilton Lime Works fossils are very scarce, an Angulatus, Icthyosaurus vertebræ, and Lima gigantea, having been found.

The diagram, the lower figure in Plate v., shews the drain which was dug at the beginning of the year up Pig-stye Lane, and down the Clifton and Hillmorton Roads, and the various depths reached. The dotted line represents the course of the drain, the letters refer to the depths.

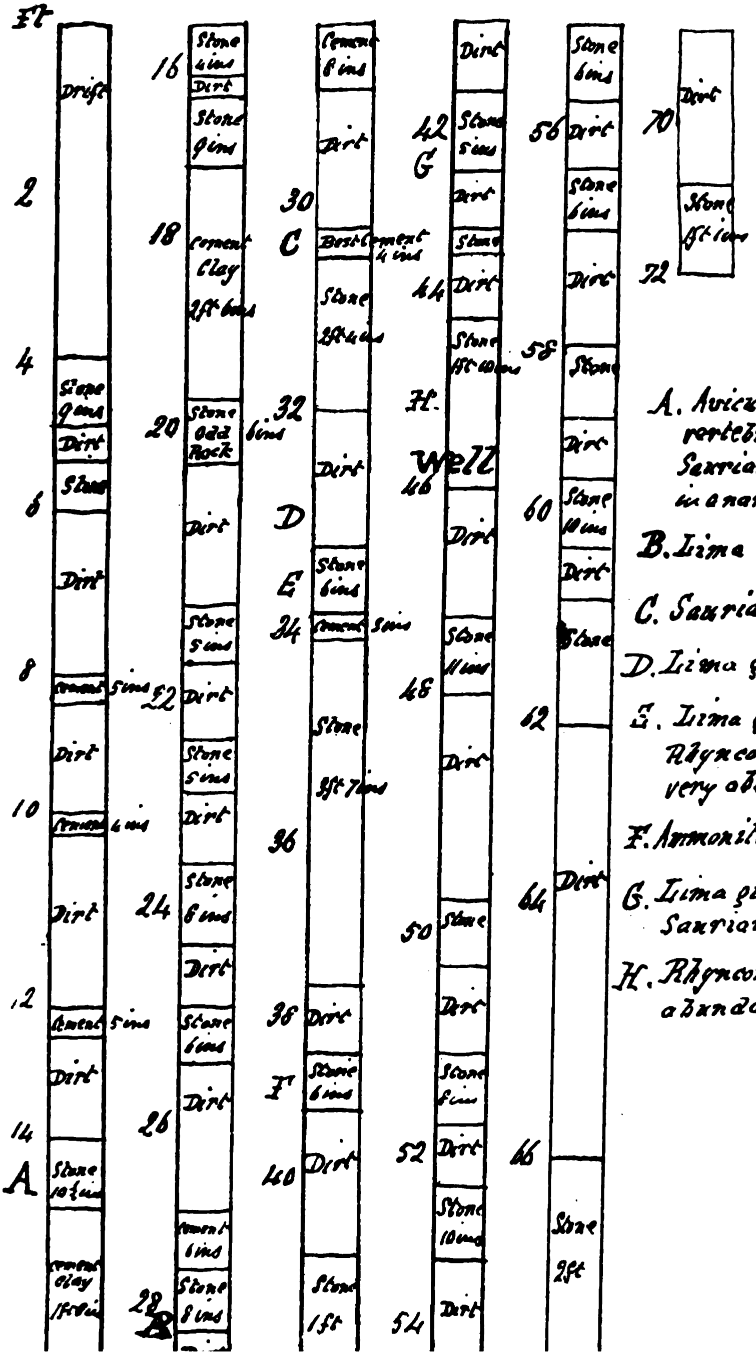
A. depth 9 ft. 6 in. gravel.
B. „ 15 „ 0 „ 12 ft. gravel, 1 ft. running sand.
C. „ 20 „ 0 „ 8—10 ft. gravel, 2 ft. red, and 4 or 5 ft. blue clay with chalk.
D. „ 19 „ 6 „ same as last.
E. „ 17 „ 0 „ 8—10 ft. gravel, sand; 2 ft. red, and 1 ft. blue clay.
F. „ 15 „ 0 „ 10 ft. gravel, sand, 3 ft. red clay.
G. „ 15 „ 0 „ same as last, with no red clay.
K. „ 8 „ 0 „ mixed clay and gravel at bottom, not like the other, gravel stones.
H. „ 19 „ 0 „ gravel and sand, 9 ft. running sand.

Explanation of Section of Victoria Lime Works.

The section (Plate vi.) was made at the junction of the upper and lower pits, and in a well; the depth reached in the pits was 46 ft., and in the well 26 ft., making a total of 72 ft.; in the strata passed through while making the well, some of that marked stone is probably cement,

PLATE. VI.

Section of the Strata exposed in the Victoria Lime Works



A. Avicula papyria, vertebrae, & ribs of Saurians, seaweeds in a narrow belt

B. Lima Gigantea

C. Saurian Remains

D. Lima gigantea

E. Lima gigantea. Rhynconella, not very abundant

F. Ammonites angulatus

G. Lima gigantea and Saurians

H. Rhynconella, very abundant

as the well-sinker counted all dirt that was not stone. The amount of stone compared with the dirt is as follows:

Stone	33 ft.	4 in.
Dirt	37 ft.	7 in.
Total	70 ft.	11 in.

Fossils presented by M. J. Brooks, from Burnley, Lancashire, all from Carboniferous Limestone;

Spirifera, 4 specimens; Euanphalus pentangulatus; Fragment of Orthoceratite; Fragment of Calamite; Group of Productus, with spires; Group of Spirifera; Productus giganteus; Goniatites, 12 specimens; Group of Ferns; Group of Encrinites; Trace of Seaweed on micaceous shale.

Fossils presented by Mr. J. W. Kershaw, Warwick;

Montlivaltia rugosa, 12 specimens, Upper beds of Lime Lias, Fenny Compton; Montlivaltia victoria, Middle Lias, Cherrington.

Geological Collection presented by Mr. A. R. Bloxam;

1. Kauri gum, Auckland.
2. Greenstone, Hokitika, New Zealand.
3. Quartzite, with grains of gold, Shortland, Auckland.
4. Pebbles from Hokitika sea-beach.
5. Quartz crystals, Browning's Pass, Westland, New Zealand.
6. Melbourne Bluestone (basaltic).
7. Auriferous quartz, 2 specimens.
8. Oamuru (Otago) building stone (fine oolite).
9. Saline incrustation on boiler.
10. Discoidal Pebbles, Hokitika.
11. Various stones, quartzites, lavas, etc., Westland, New Zealand.
12. Soapstone.
13. Fossil Shells, apparently tertiary.

W. B. Lowe.

Inserted — in England [illegible]

Entomological Section.

The following is a complete list of the Lepidoptera, which have been marked as noticed within 8 miles of the School Close.

Diurni, or Butterflies.

- **Leucophasia**
  - **Sinapis**
- **Pieris**
  - — **Brassicæ**
  - — **Rapæ**
  - — **Napi**
- **Anthocharis**
  - — **Cardamines**
- **Gonopteryx**
  - — **Rhamni**
- **Colias**
  - — **Edusa**
- **Argynnis**
  - — **Paphia**
  - **Aglaia**
  - — **Adippe**
  - — **Euphrosyne**
  - — **Selene**
- **Vanessa**
  - — **C-album**
  - — **Urticæ**
  - — **Polychloros**
  - — **Io**
  - **Antiopa**
  - — **Atalanta**
  - **Cardui**
- **Satyrus**
  - — **Ægeria**
  - — **Megæra**
  - — **Janira**
  - — **Tithonus**
  - — **Hyperanthus**
- **Chortobius**
  - — **Pamphilus**
- **Thecla**
  - — **Quercus**
- **Polyommatus**
  - — **Phlœas**
- **Lycæna**
  - — **Alexis**
  - **Adonis**
  - — **Argiolus***
- **Syrichthus**
  - — **Alveolus**
- **Thanaos**
  - — **Tages**
- **Hesperia**
  - — **Sylvanus**
  - — **Linea**

Nocturni, or Moths.

- **Smerinthus**
  - — **Ocellatus**
  - — **Populi**
  - — **Tiliæ**
- **Acherontia**
  - — **Atropos**
- **Sphinx**
  - — **Ligustri**
- **Deilephila**
  - **Galii***
- **Chœrocampa**
  - — **Elpenor**
  - **Porcellus**
- **Macroglossa**
  - — **Stellatarum**
  - — **Fuciformis**
- **Sesia**
  - — **Tipuliformis**
- **Zeuzera**
  - **Æsculi**
- **Cossus**
  - — **Ligniperda**
- **Hepialus**
  - — **Humuli**
  - — **Sylvanus**
  - — **Lupulinus**
  - — **Hectus**
- **Procris**
  - — **Statices**
- **Zygæna**
  - — **Filipendulæ**
  - — **Loniceræ***
- **Nudaria**
  - — **Mundana***
- **Calligenia**
  - **Miniata**
- **Lithosia**
  - — **Complanula**
- **Chelonia**
  - — **Caja**
- **Arctia**
  - — **Lubricipeda**
  - — **Menthastri**
- **Liparis**
  - **Chrysorrhœa**
  - — **Auriflua**
  - — **Salicis**
  - **Monacha**
- **Orgyia**
  - — **Pudibunda**
  - **Fascelina**
  - — **Antiqua**
- **Trichiura**
  - — **Cratægi***
- **Pœcilocampa**
  - **Populi**
- **Bombyx**
  - **Neustria**
  - — **Quercus**
- **Odonestis**
  - — **Potatoria**
- **Lasiocampa**
  - — **Quercifolia**

RADCLIFFE.

Uropteryx
— Sambucaria
Rumia
· Cratægata
Metrocampa
-- Margaritaria
Eurymene
Dolabraria
Pericallia
— Syringaria
Selenia
Illunaria
Lunaria
— Illustraria
Odontopera
— Bidentata
Crocallis
Elinguaria
Ennomos
Angularia
Phigalia
— Pilosaria
Nyssia
— Hispidaria*
Biston
— Hirtaria
Amphidasys
Prodromaria
— Betularia
Hemerophila
Abruptaria
Boarmia
— Repandaria
— Rhomboidaria
— Abietaria
Pseudoterpna
Cytisaria
Iodes
— Lactearia
Hemithea
Thymiaria
Ephyra
— Punctaria
Asthena
— Luteata
— Candidata
— Sylvata
Acidalia
— Scutulata
— Bisetata
— Incanaria
— Remutata
Imitaria
— Aversata
— Emarginata
Timandra
— Amataria
Cabera
— Pusaria
— Exanthemaria
Macaria
— Liturata
Halia
— Vauaria
Strenia
— Clathrata
Fidonia
— Piniaria
Abraxas
— Grossulariata
Lomaspilis
— Marginata
Hybernia
— Rupicapraria*
Progemmaria
— Defoliaria
Anisopteryx
Æscularia
Cheimatobia
— Brumata
Boreata
Oporabia
— Dilutata
Larentia
— Didymata
— Pectinitaria
Emmelesia
— Alchemillata
— Albulata
— Decolorata
Eupithecia
— Castigata
— Lariciata
— Vulgata
— Exiguata
Hypsipetes
— Elutata
Melanthia
— Ocellata
Albicillata
Melanippe
— Tristata*
— Subtristata
— Montanata
— Fluctuata
Anticlea
— Rubidata
Badiata
Derivata
Coremia
— Ferrugata
Camptogramma
— Bilineata
Scotosia
— Dubitata
— Vetulata
— Certata
Undulata
Cidaria
· Miata
— Corylata
— Russata
— Suffumata
Populata
— Fulvata
— Pyraliata
Eubolia
— Mensuraria
Anaitis
-- Plagiata
Chesias
— Spartiata
Tanagra
Chærophyllata

Platypteryx
— **Falcula**
Cilix
Spinula

Dicranura
— **Furcula**
— **Vinula**
Pygæra
— **Bucephala**
Ptilodontis
Palpina
Notodonta
— **Camelina**
— **Dictæa***
Diloba
— **Cæruleocephala**
Thyatira
— **Derasa***
Bryophila
— **Perla**
Acronycta
— **Tridens**
— **Psi**
Aceris
— **Megacephala**
— **Alni**
• **Rumicis**
Leucania
Pallens
Gortyna
— **Flavago***
Arylia
— **Putris***
Xylophasia
— **Lithoxylea**
• **Polyodon**
Luperina
Testacea
Mamestra
— **Brassicæ**
Persicariæ
Apamea
— **Basilinea**

— **Oculea**
Miana
— **Strigilis**
Fasciuncula
— **Arcuosa**
Grammesia
— **Trilinea***
Agrotis
Suffusa
Segetum
— **Exclamationis**
Tryphæna
Ianthina
Interjecta
Orbona
— **Pronuba**
Noctua
Xanthographa
Tæniocampa
— **Gothica**
— **Instabilis**
— **Stabilis**
Munda
Cruda
Orthosia
Upsilon
Lota
Anchocelis
— **Pistacina**
Litura
Cerastis
Vaccinii
Spadicea
Xanthia
Ferruginea
Cosmia
Diffinis
Polia
— **Chi**

— **Flavicincta**
Miselia
Oxyacanthæ
Agriopis
Aprilina
Phlogophora
— **Meticulosa**
Euplexia
— **Lucipara***
Hadena
Protea
Glauca
Calocampa
Exoleta
Cucullia
Verbasci
— **Umbratica**
Heliodes
— **Arbuti**
Brephos
— **Notha***
Plusia
Chrysitis
Festucæ
— **Iota**
— **Gamma**
Gonoptera
— **Libatrix**
Mania
Typica
Maura
Catocala
Nupta
Euclidia
Mi
— **Glyphica**

Hypena
— **Proboscidalis**
Herminia
— **Tarsipennalis**

Aventia
– Flexula

Aglossa
Pinguinalis
Pyrausta
— Purpuralis
Herbula
– – Cæspitalis
Cataclysta
— Lemnalis

Paraponyx
— Stratiotalis
Hydrocampa
— Nymphæalis
— Stagnalis
Botys
— Urticalis

Ebulea
— Sambucalis
Pionea
— Forficalis
Scopula
—· Lutealis
– Olivalis
— Prunalis

Scoparia
—Ambigualis

Crambus
–– Pratellus

— Pascuellus
— Perlellus

—– Culmellus
–– Hortuellus

Halias
– Prasinana
Tortrix
—. Rosana
. Ribeana
— Viridana
Peronea
– Variegana
Dictyopteryx
– Lœflingiana
– – Bergmanniana
Penthina
· Pruniana
– Cynosbana
Pardia
. Tripunctana

Sericoris
— Lacunana
— Urticana
Cnephasia
— Musculana
Sciaphila
— Subjectana
— Hybridana
Phoxopteryx
— Diminutana
Grapholitha
—· Campoliliana
Phlœodes
—· Tetraquetrana
Coccyx
— Strobilana

—– Hercyniana
Endopisa
— Nebritana
Stigmonota
— Perlepidana
Pyrodes
— Rheediana
Xylopoda
— Fabriciana
Lobesia
—· Reliquana
—– Servillana
Xanthosetia
–· Hamana
Tortricodes
–· – Hyemana

Diurnea
Fagella
Incurvaria
Muscalella
·— Oehlmanniella
Micropteryx
— Calthella
— Seppella
– Allionella
Nemophora
. Swammerdammella

Adela
— DeGeerella
—Viridella
Swammerdammia
—Pyrella
Phibalocera
— Quercana
· Depressaria
— Applana
Chærophylli

Dasycera
Sulphurella
Œcophora
—Unitella
—Pseudospretella
Endrosis
—Fenestrella
Glyphipteryx
—Fischeriella
Argyresthia
—Nitidella

Gracilaria
  Swederella
Ornix
  Anglicella
Coleophora
  Nigricella
Pterophorus
  Trigonodactylus
Alucita
  Polydactyla

Chrysoclysta
  Flavicaput
Elachista
  Rufocinerea
  Cygnipennella
  Pentadactylus

Tischeria
  Marginea
Lithocolletis
  Cramerella

The occurrence of species marked * is doubtful.

The best species added to our local list this year was Vanessa Antiopa, taken in Coombe Wood by H. Vicars.

On account of the warm season the beginning of the year, butterflies were noticed as early as Feb. 10.

Melanippe Montanata appeared in profusion in the summer along the fences. M. Brassicæ and larvæ of Persicariæ were also very abundant.

At the beginning of June eggs and larvæ of D. Vinula (the Puss Moth) may be found in some profusion on the young bushes at the base of an aspen tree, about 50 yards on the north side of Rainsbrook, on the east side of the road.

A. SIDGWICK.
A. F. BUXTON.

Botanical Section.

This Section has met every fortnight at the President's house. Papers have been read by the President on the Cross-Fertilization of Plants, Arbutus, Mimulus, Tropœolum, etc., and by G. L. King on the Structure of Grasses: but the main work of the Section, besides the construction of the Floral Calendar, has been an attempt to put the local herbarium in such a form that it can be handled by the Society without fear of damage or disarrangement.

With regard to the fertilization of the arbutus, which seems to require the intervention of insects, E. T. Wise reports that there are 6 arbutus bushes in Rugby;

1 in Mr. Wilson's garden, hardly bearing any fruit;

1 in Mrs. Vicars' garden, bearing a few berries, which however do not ripen;

1 in the Cemetery, which bears an abundance of berries;

3 in Mr. T. Caldecott's grounds, one of which bears fruit in abundance, while the other two, though quite close to it, bear no berries.

The following is the list of new plants and new localities for the year;

Ranunculus aquatilis, b. floribundus, Bab.,—new variety. H. W. T.
Thlaspi arvense—plentiful near Frankton; new locality. H. G. W.
Brassica nigra—new for this list, in cornfield near Cawston, October 8, 1872. H. G. W.

Reseda lutea—field to left of Clifton Road; new locality. F. E. K.

Cerastium semidecandrum—hitherto overlooked; found by J. A.

Linum perenne—a specimen of this doubtful plant was brought to H. G. W. as growing in waste ground near Horton Crescent.

Trifolium medium—remove brackets as being found by H. W. T. near lime-works, Lawford Road.

Attention is called to the two forms of Cherry, and two forms of May, all to be found at Rugby.

Viburnum Lantana. J. A.

Verbena officinalis—quoted on authority of Mr. Baxter as growing "about Rugby" 40 years ago or more, but not since heard of. I found a single stunted specimen of this plant—just enough to show that it might grow about here—in a cornfield near Lawford Hall, September, 1872. H. G. W.

Lamium amplexicaule, var. intermedium—a new variety growing in the allotments at the top of the hill on the Dunchurch road. The flowers rarely open, but much seed is formed notwithstanding. F. E. K.

Galeopsis Ladanum—not supposed to have been found within distance before, though a common weed elsewhere. Found in potato field near Church Lawford. H. G. W.

Echium vulgare—in a corn-field near Hungerfield, by Rev. A. Bloxam; the locality given by E. T. Wise, at Hillmorton, has proved a wrong one.

Salix purpurea, var., Helix L. F. E. K.

Alopecurus agrestis. J. A.

Avena pratensis. E. T. W.

Polystichum aculeatum—remove brackets, found at Barby.

The Rev. A Bloxam has sent the following notices of plants found near Harborough Magna in 1872;

Prunus Cerasus and *Avium*—hedges.

Rosa decipiens, Dumont—below Harborough.

Rosa bibracteata, Basl.—Cathiron Lane.

Epilobium roseum—in a ditch on the right, before ascending the hill to Easenhall.

Pimpinella magna—recorded for 1871, to be considered doubtful.

Viburnum Lantana—hedge between Harborough and Cosford.

Galium Mollugo.

Asperula odorata—Cathiron Lane.

Helminthia echioides.

Picris hieracioides.

Carduus eriophorus—a single plant by side of an old canal.

Verbascum Thapsus.

Thymus Chamædrys—fields between Harborough and Cosford.

Lithospermum officinale—in Montelo Lane.

Rumex Hydrolapathum—Canal side.
Rumex pratensis—pond near Cathiron Lane.
Orchis latifolia.
Triglochin palustre—Canal side.
Potamogeton zosterifolius—Canal side.
Sparganium simplex.
Juncus diffusus.
Juncus compressus.
Ophioglossum vulgatum—several localities at Harborough.
Equisetum palustre—Canal bank.

The following is the table of the year. (See Report for 1870, p. 7.)

		Average heat at 8.30 a.m.	Total rainfall in inches.	Dates of Flowering.	Excess of heat or deficit.	Excess of rain or deficit per ½ month.
Jan.		36.3	3.84	21 days early (3 obs.)	+ 2.3	+ .96
Feb.		39.3	2.27	18 days early (24 obs.)	+ 3.0	+ .43
March		37.7	1.15	19 days early (23 obs.)	+ 4.4	— .24
April		46.9	2.51	8 days early (42 obs.)	— 2.7	+ .47
May	1—15	49.8	1.75	3 days early (35 obs.)	— 1.1	+ .78
	16—31	53.7	.43	2¾ days early (24 obs.)	— 2.8	— .47
June	1—15	56.6	2.45	¼ day late (32 obs.)	— 1.9	+ 1.04
	16—30	59.2	1.95	1¼ day late (16 obs.)	+ 2.9	+ 1.15
July	1—15	60.3	2.65	2½ days early (9 obs.)	+ .2	+ 1.29
	16—31	62.3	1.69		+ 1.8	+ .44

The floral dates have been carefully taken during the year, the chief workers being the President, H. G. Wauton, J. Armitage, E. T. Wise, and H. W. Trott. The President takes this opportunity of thanking several ladies who assisted him by constantly bringing him specimens.

The earliness of the year is very remarkable; almost every flower recorded in the first 3 months of the year was found out at dates preceding their mean date.

The following dates are especially noteworthy:
Heracleum sphondylium—Cow-parsley, Feb. 25.
Anthriscus sylvestris—Chervil, Feb. 20.
Geum urbanum—Avens, Feb. 28.
Potentilla fragariastrum—Barren Strawberry, Feb. 27.

Lists of plants still out on Oct. 1st and Nov. 1st were taken.

On Nov. 1st there were noted the following numbers from the London Catalogue: 19, 40, 51, 63, 136, 185, 191, 235, 249, 272, 317, 340, 438, 486, 498, 559, 563, 588, 590, 643, 648, 660, 661, 671, 675, 760, 828, 831, 838, 852, 962, 972, 978, 979, 1313, 1328, 1339, 1356, 1368.

Besides these, on Oct. 1st we found out 20, 163, 164, 171, 188, 206, 271, 301, 321, 332, 475, 487, 508, 526, 573, 584, 595, 601, 602, 649, 664, 738, 785, 825, 834, 903, 939, 971.

These lists, although not supposed to be exhaustive, may yet be useful.

On a Pelorian form of Linaria vulgaris. The following is a summary of two Papers read to the Society on May 25th, and October 5th, by Mr. Kitchener.

In July, 1871, I gathered for the Long-list examination a large number of specimens of Common Toadflax at Clifton, on the left hand of the road from Clifton to Hillmorton, a little beyond the first corner from Clifton.

On returning home I found that several of my specimens deviated from the ordinary form, and moreover did not exhibit the normal pelorian five-spurred form (for a figure of which see Oliver, p. 209).

The chief points observed in 1871 were that the terminal flowers of the raceme were the most often, and most completely pelorian: but many of the lower flowers were to some extent abnormal: the number of spurs in the terminal floret was 7, 8 or more: 7 being the commonest number: when the spurs were 7, the sepals were 8. The lateral florets on the raceme exhibited 1, 2, 3, 4, and 5 spurs: a very common form being one big spur with two little protuberances, incipient spurs on each side.

I did not find the observation of the French botanist M. de Melicoq confirmed, to the effect that 'on the weakest plants the peloriated flower was at the top of the stem, while on stronger plants with more numerous and larger foliage the peloriated flowers were chiefly found at the centre and base of the inflorescence, and their pedicels were much larger than usual'; but more observations on this point are desirable.

The soil on this spot did not appear at all rich; the flowers grew in a hedge, and on the inside of the hedge along the edge of a corn-field: all along the same hedge were masses of specimens of the plant, but not exhibiting any pelorian forms at all.

On the 25th July, 1872, I went back to the spot, and found hardly any blossoms out; one terminal pelorian was in bud.

September 11, 1872, all the plants in full bloom.

At the spot where I gathered pelorians the previous year, I found the nature of the pelorianism had changed: (1) every pelorian observed was a terminal flower; (2) no pelorian had less than 5 spurs; (3) in every plant which had any pelorian flowers, most, if not all the racemes had the terminal blossom, pelorian.

In the faded pelorian flowers, there were no ripe capsules, but some seemed ripening.

I examined about 30 pelorian flowers.

On plant I., the numbers of spurs were 6, 6, 5, 5, (the fifth divided into 3), and 11 spurs very confused; on plant II., 5, 5, 8; on plant III., 5, 6, 5, 5; on plant IV., 6, 7, 8, 10, 8 confused, 7, 8, 5, 7, 7, 8; and from other plants, 7, 8, 5, 12. We thus have out of 27 blossoms, 9 with 5 spurs, 4 with 6, 5 with 7, 6 with 8, 1 with 10, 1 with 11, 1 with 12.

I will give details of 3 of the more striking flowers.

(*a*) In one blossom from plant II. above, I found 11 sepals, 11 palates, 11 lobes, 9 spurs, 2 bifurcating, 8 stamens, stigmas quadrangular, ovary 4-celled: evidently two blossoms in one.

(*b*) In a flower from plant III. above, I found 3 or 4 abortive flowers round the blossom, almost reduced to bracts, then in the flower proper 7 sepals, 6 lobes at right angles to the tube, 6 palates, 5 spurs, 1 cleft, 6 stamens, (spur and stamen alternating), ovary 2-celled. In this flower every spur was bored by insects.

(*c*) From plate IV., 9 sepals, 9 spurs 1 turned inside out, 9 stamens, 5-celled ovary, stigma very large and thick, style hollow and out of all proportion, and consisting of an inner tube inside an outer tube: seeds in two layers between the two tubes, and inside the inner tube, the outer row of seeds being in 5 clumps: when I made a section near the base of the pod, the inner tube had disappeared.

Several abortive flowers grew at its base, consisting apparently of a bract, and a pistil, with no ovary, but stigmatic papillæ at its summit.

On September 17 I revisited the spot, and discovered that, whereas the plants at the part I had visited last year had changed their method of pelorianism, some other parts of the same hedge which in 1871 had borne only normal flowers, now exhibited plants with the same stage of pelorianism as I had found in 1871 in the other spot. Here I found again blossoms other than the terminal blossom of the raceme, exhibiting 2, 3, 4, and 5 spurs, and especially the lowest blossom of the raceme.

This will be seen from the following numbers of spurs in different racemes from the same root stock: the number of flowers on a normal raceme was 11—16 flowers: when the contrary was not expressed, the lower flowers were normal, or 1 spurred.

Branch (1), 5, 5, 5, 5, 1, 5, 4, 2, 3; (2), 4; (3), normal; (4), 3, 3, 3, *ad inf.*; (5), 4, 4, *ad inf.*; (6) and (7), normal; (8), 5, 6, none others out; (9), this was the lowest axillary raceme and had only six blossoms; the lowest of the six had 5 spurs, the rest normal; (10), 5, 6, terminal blossom normal; (11), 5, 5, 5; (12), 1, 2, all blossoms weak; (13), 6, 1, 5, 5, 6, 5; (14), 6, (one three-fid).

I have made notes of 13 of the most peculiar flowers, no two being exactly alike, but the notes are too long to print here.

One point struck me as possibly affecting the question, viz., that in many blossoms every single spur was bored by insects. The flowers were full of a little beetle which W. C. Marshall has named as Meligethes æneus. If it is these little insects that bore the flowers, I wish the entomological section would tell me why they take the trouble to bore their way in from the outside, instead of quietly walking down the mouth of the corolla.

The point for examination in 1873 is whether the patch of plants which in 1872 exhibited the incipient stage of pelorianism, will in 1873 have passed into the second stage, in which only the terminal florets are pelorian, and these never have less than 5, and indeed as much as an average of over seven spurs. In this second stage apparently the pelorianism is confined to certain terminal florets, which in the majority of cases consist of more than one floret welded together. Such a multiple flower may often be observed at the top of the raceme of a garden fox-glove.

F. E. Kitchener.
E. T. Wise.

W. BILLINGTON, PRINTER, RUGBY.

RUGBY SCHOOL
NATURAL HISTORY SOCIETY.

1873.

PRINTED BY
W. BILLINGTON, MARKET PLACE,
RUGBY.

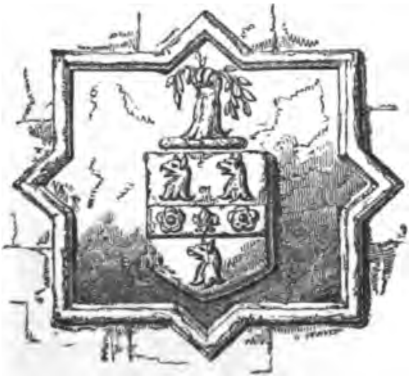
REPORT

OF

THE RUGBY SCHOOL NATURAL HISTORY SOCIETY

FOR THE YEAR

1873.



"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1874.

PREFACE.

We are seven years old, and with advancing years come the sense of increasing responsibilities, and the necessity for increased exertions. With the constant influx of new blood, we need not fear that we shall lose the elasticity of youth: but when a Society has once become an established institution in a School, the Members are inclined to believe it runs along with no friction, and requires no fresh impulse of any sort from them. Let the Editors, and especially the dying President, assure them that this is a mistake. Whatever other discoveries the Society may have made, it has not yet discovered the secret of perpetual motion.

There is no need however to be gloomy, or despairing: in taking leave of a Society which he has watched with increasing affection for so many years, the President feels no doubt of its continued success. At no time in its history does it seem to him that there were more promising workmen in it, or better work cut out for them to do. Witness, for one thing, the vigorous way in which within the last few weeks volunteers have come forward to take a share in the *magnum opus* of a Geological model of the Rugby district.

The Observatory Report again shows work, and work in which our younger heads have taken their share. Let us call the attention of the School to the invitation printed below to all who care about it to avail themselves of the Temple Telescope.*

Our Botanical Report is conspicuous by its absence; it has been crowded out by other things, but, if possible, it will make its appearance later in the form of a revised flora of the district.

The Reports of the other Sections are rendered rather meagre by the absence of Mr. Sidgwick from England, and by the loss which the leaving of C. M. Chadwick has been to the progress of our Zoological collection.

Our Minutes will show that an increasing number of Papers have been read during the year by the Members themselves, while we have had the good fortune to secure the kind help of three older hands, Mr. R. Scott, Dr. Oldham, and Mr. Whitaker.

---

* Mr. Wilson and Mr. Seabroke will be glad to see any Member of the School at the Observatory on fine nights from 9.15—10.30 P.M. Not more than 3 should come from any House on the same night.

a 2

In concluding our preface, we may perhaps be allowed to say one word of respect to the memory of Mr. Billington, who, at all times a good friend to the School, has been more especially *our* friend by generously publishing our Report for several years.

F. E. Kitchener, President.
L. Maxwell, } Editors.
Easter, 1874. H. N. Hutchinson, } Editors.

NATURAL HISTORY SOCIETY'S ACCOUNTS FOR 1873.

Receipts.

		£.	s.	d.
By balance (see last Report)		8	5	1
Compositions		11	10	0
Subscriptions, Lent Term,	£2 15 0	6	17	6
Ditto, Trinity Term,	2 7 6			
Ditto, Advent Term,	1 15 0			
Sale of old Reports		0	7	0
		£26	19	7

Expenses.

	£.	s.	d.
Egg Cabinet (repaired)	0	17	6
Wright's bill (Cabinet for Reptiles)	2	11	6
Books and Periodicals	2	8	5
Prizes	2	2	0
Reports distributed to the Society, etc.	4	12	0
Cost of Anastatic Drawings	3	7	6
Bottles and Spirits of Wine	1	19	1
Men for Mr. Scott's Lecture	0	4	6
Cost of gas for Mr. Smith's Lecture	0	7	6
Postage and Carriage	0	4	9
	£18	14	9
To Balance in President's hands	8	4	10
	£26	19	7

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

---

* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

LIST OF THE SOCIETY, LENT TERM, 1874.

Officers:

President: Mr. F. E. Kitchener, F.L.S.
Secretary: H. N. Hutchinson
Curator: F. W. Dutton
Editors: The President, L. Maxwell, H. N. Hutchinson
Album Keepers: Botanical, E. T. Wise
" " Geological, L. Maxwell
" " Entomological, H. Vicars
" " Zoological, B. R. Wise
Entomological Curator: Mr. A. Sidgwick

Honorary Members:

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. Elsee
Rev. C. E. Moberly
Mr. C. Dukes, B. Sc.
Mr. Percy Smith, F.C.S.

Corresponding Members:

Lord Bishop of Exeter
G. F. Helm, M.D.
E. P. Knubley, 68
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H. M. Geological Survey
C. L. Rothera, B. Sc. 68
F. W. Fison, F.C.S.
C. S. Taylor
E. Cleminshaw
G. B. Longstaff, F.C.S., 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
R. E. Baynes
F. R. Smith
E. W. Prevost, D. Ph., F.C.S.
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S., 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H. M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
C. Hinton
E. Burchardt
A. S. Napier
R. H. Ker
A. G. Burchardt
R. H. Scott, F.R.S.
W. B. Lowe
Rev. C. J. E. Smith
F. Spurling

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year. We have omitted from this list the names of those who left the School before the passing of Rule xiii, and have never since leaving made any communication to the Society. Any of these, who wish to have their names replaced on the list should communicate with the President.

Members:

E. T. Wise
B. R. Wise
H. N. Hutchinson
L. Maxwell
F. W. Dutton
H. Vicars
G. L. King
H. W. Trott
A. J. Solly
L. Knowles
V. H. Veley

Associates:

H. W. Scholfield
W. H. Cross
S. Bolton
J. W. Johnson
W. A. Sparrow
J. Y. Bostock
H. B. Hemming
W. H. Prichard
T. B. Eden
J. R. Hutchinson
T. F. Johnson
L. Parry
J. O. Beuttler
A. Henderson
W. W. K. Clarke
G. J. Foster
C. H. Sargant
J. N. Stolterfoht
A. Duff
S. Crosse
G. De S. Hamilton
A. Pearson
J. H. Kingdon
A. Ward
H. F. Newall
M. V. Hilton
W. J. Napier
R. Cunliffe
L. McMahon
E. Inglis
S. King
W. S. Benyon-Winsor
W. Abraham
G. A. Solly
F. Hutchinson
C. A. James
R. A. Fayrer
H. Hurrell
R. H. B. Bolton
R. D. Oldham
G. Varley
D. P. Kingsford
H. L. Baggallay
C. M. Cunliffe
W. Larden
T. A. Wise
H. T. S. Houghton
W. B. Thornhill
J. Y. Johnson
H. W. Fowler
H. F. Wilson
E. J. Power
H. Willis
M. J. Michael
H. Symonds
H. V. Armour
W. Calvert
H. I. Davis
C. Bayley
W. F. Hawtrey
A. C. Bannister

LIST OF PAPERS.

PAGE
On Home-made Electrical Apparatus, by H. N. Hutchinson* - 2
On an Excursion of Mr. Wilson's Geological Class to Mount Sorrel, by C. M. Kerr* - - - - - - - - 7
On the Rugby Drift, by Mr. J. M. Wilson - - - 10
On a Botanical Expedition to Princethorpe, by H. W. Trott* - 14
On Cohesion of Water at various Temperatures, by W. B. Lowe* 15
On an Abnormal Flower of Foxglove, by Rev. C. J. E. Smith - 18
On a Geological Expedition to Atherstone and Nuneaton, by E. Mann* - - - - - - - - 19
On Experiments on Ants, by Mr. A. Sidgwick - - - 22
On an Entomological Expedition to Frankton Wood, by H. A. Bull* 24
On Teesdalia nudicaulis, by the President - - - 25
On the Chameleon, by J. S. Beuttler* - - - - - 27
On the Weather, by Mr. R. H. Scott, F.R.S. - - - 31
On Sesia apiformis, by Mr. W. C. Marshall - - - 43
On Coal Fields of British India, by Dr. Oldham - - - 45

Astronomical Report (Temple Observatory) - - - 55
Meteorological Report - - - - - - - 57
Entomological Report, by H. Vicars* - - - - 63
Zoological Report, by C. M. Chadwick* - - - - 63
Geological Report, by L. Maxwell* - - - - 64
List of Papers on the Geology of Warwickshire, by Mr. W. Whitaker - - - - - - - 66

LIST OF PLATES.

PLATE I. Home-made Electrical Apparatus, by H. N. Hutchinson* 2
PLATE II. Figs. i. and ii. Abnormal Foxglove, from photographs, by H. N. Hutchinson* - - - - - 18
Fig. iii. Cocoon of Sesia apiformis, by the same - 18
PLATE III. Oolitic Drift at Brownsover, by L. Maxwell* - 64

---

* These are, or were at the time, actual members of the School.

MINUTES OF MEETINGS.

MEETINGS HELD FEB. 1, *MAY* 10, *MAY* 26, 27, *JUNE* 9, *and SEP.* 27, 1873.

At these Meetings only private business was transacted.

MEETING HELD FEB. 8:—*Donation:* Ferns and Woods from Otago, New Zealand, sent by an Old Rugbeian.

Mr. Wilson made some remarks on the Fossil remains of Butterflies from the Lower Oolite, to be seen at the Oxford Museum.

The report of the Temple Observatory and the report of the Meteorological Committee for the past year were then read.

The Rev. T. N. Hutchinson then gave an account of the process of Smelting Copper at Swansea, and exhibited a number of specimens illustrating the various stages of the process.

MEETING HELD MARCH 8:—*Donations:* Diagrams of typical species of Insects and Fishes, by A. J. Harvey, Esq.

Bones and teeth of Hyæna, Elephant, Lion, Rhinoceros, Deer, etc., together with flint instruments, from a cave near

Haverfordwest, by J. R. Allen (O. R.); Collection of Fossils from the Menevian and Cambrian rocks, near St. David's, by the same.

Exhibitions: Ammonites Bucklandi, by F. Arnold. Case of Jewels and precious stones, cut and uncut, in various stages, by Rev. T. N. Hutchinson.

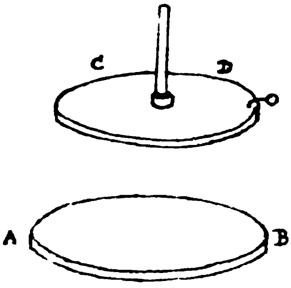
H. N. Hutchinson (member) then read a Paper on '*Home-made Electrical Apparatus.*' The object of the Paper was to show how cheaply electrical apparatus can be made, and was illustrated by experiments performed with the home-made apparatus described in the Paper.

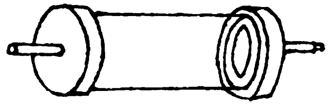
The following extracts are taken from the Paper:—

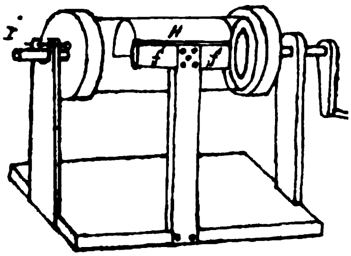
'Descriptions how to make electrical machines may be found in many books, but they frequently require a considerable outlay, both of time and money. The object of the following Paper is to show how an electrical machine and several useful pieces of apparatus may be made at a very small cost and in a simple way, and at the same time such as to give good results. The apparatus described in this Paper was made by my brother and myself four or five years ago. I have only selected a few things out of a great many that we contrived, but it may be sufficient to show how easy it is to make sufficient electrical apparatus for a great number of experiments. I shall only describe how we made an electrophorus, cylinder machine, leyden jars, dischargers, bell jar for pith figures, and electrical pistol. Plate i. contains outline sketches from the things themselves, which I will take in the order just given.

'To begin then with the electrophorus. AB Plate i. is a circular tray made in tin 12 inches in diameter, the rim being ½ inch high. Into this a mixture of equal parts of Venice turpentine and resin is poured, after being heated in a ladle. It should then be placed quite level over a hot stove, in order to let it settle down to a smooth and flat surface. CD is a disc of wood, with rounded edges 10 inches in diameter carefully

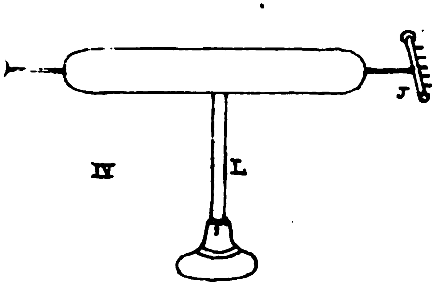
Plate. I.



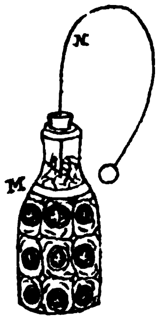

II



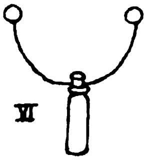
III

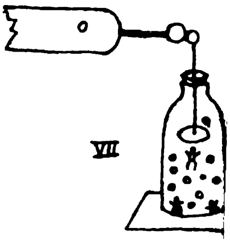


IV

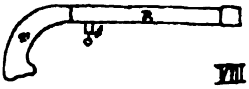


V


VI



VII



VIII

covered with tinfoil, leaving no rough points. A glass rod is fixed into this for a handle. In order to get sparks the tray must be warmed and then rubbed briskly with hot flannel (or better, cat's skin). The disc CD is then placed on the surface of the resin and touched with one finger. On removing it, a spark often an inch long may be got from the knob. This may be repeated many times without fresh rubbing.

'ELECTRICAL MACHINE.

'Choose a tall glass jar, such as you see in confectioners' shop-windows. This is to be the cylinder which must be mounted and made to turn in a stand, with a rubber pressing against it. Next get two wooden caps turned to fit on to the ends of the cylinder, about an inch deep, with projecting pivots. The caps are next to be cemented on to the ends of the cylinder. The cement is composed of resin, beeswax, red ochre, and a little plaster of Paris, and must be heated over a slow fire. The open end of the cylinder must be first covered over with a piece of silk to prevent bits falling in. This done, we have what is shewn in Fig. ii.

'The stand in Fig. iii. is made of deal. E is the support of the rubber FF, and is made of thin deal firmly screwed to the stand, so as to press tightly against the cylinder. Some rubbers have a screw at G by which to press them more tightly against the cylinder, but the thin support will give pressure enough. On the interior side of FF is a cushion of leather stuffed with horsehair, over which comes a silk flap exactly the same size, which is glued along the bottom of the strip of wood FF. This flap carries the amalgam.

'The amalgam which we have used is made by kneading together tinfoil and mercury, until they become a sort of paste. The silk flap on the rubber must be slightly greased with tallow, and then just as much amalgam spread on as will adhere. This will give a greatly increased effect to the machine. Behind the silk flap just described is glued, in the same way, another and larger one, H, coming half-way down the other side of the cylinder. This flap is glued on first, and then the other over it. The handle may be made of strong wood, with a square hole fitting on to the end of the pivot. To amalgamate the rubber the cylinder must be taken out by removing the pin I and the handle.

'This done, warm the machine, and then turn it in the dark, and you will see flashes of light on the glass, and light bodies will be attracted to it. Thus with this much of a machine we get some electrical effects, but we want something which we can charge with electricity—in fact, we want a conductor.

'THE CONDUCTOR.

'In all bought machines this is made of brass or tin, but an equally good one may be made by getting the same shape turned in deal wood, and covering it very smoothly with tinfoil. The one in Fig. iv. is made in this way, the wooden part being 10½ inches long, and rather more than 2 inches in diameter. The fork J may be turned in wood without the points, covered with tinfoil, and then pins put through from the back. The balls at each end prevent loss of electricity. A thick brass wire joins this to the wooden part. From the other end comes a similar wire, to the end of which is fastened a wooden ball covered with tinfoil. L is a thick glass rod (varnished with sealing wax, or shellac dissolved in spirits of wine, to keep off damp), which is fastened into a wooden stand. It is best to have a large conductor. The first conductor we made was not nearly as large as our present one, and consequently did not give such good results.

'LEYDEN JARS.

'A very good Leyden jar may be made with an ordinary plum jar, by lining it with tinfoil inside and outside nearly up to the top, and plugging the mouth with wood. Through this wood comes a thick wire, from the bottom of which hangs a chain touching the inside of the jar. The top of the wire has in most cases a brass ball. But an oak-ball covered with tinfoil makes a very good substitute. The covering must be quite smooth. This will be hard to do at first, and will require practice. The points should be rubbed down with the finger nails. It is worth while to get a good many round oak-balls and cover them with tinfoil, as they will be found very useful.

'To line the inside of a jar is a difficult thing and cannot be done when the jar has only a small mouth, since the tinfoil must be smoothened by putting one's hand inside. Instead of this we may drop sheets of Dutch foil one upon the other inside the jar, so as to nearly fill it up. (Dutch foil is something like gold leaf, and may be got at 2d. per book at the chemists.)

'The jar in Fig. v. is called a "spangle jar." The inside is filled as just mentioned, but the outside coating instead of being tinfoil consists of fancy paper, with a pattern either in gold or silver. Round the top of the paper at M is pasted a strip of tinfoil. The wire N is bent so as nearly to touch this band. Thus when the jar is sufficiently charged a flash goes from the knob at the end of the wire (which is an oak-ball covered with tinfoil) to this tinfoil band, and from thence spreads itself all over the gilt part of the pattern, producing in the dark a very pretty effect. The jar used in this case is an old pickle bottle, as perhaps Fig. v. may suggest, and answers very well.

'I may here mention that by passing sparks from the conductor on to the gilt edges of a book, or the pattern outside, or any metallic pattern, very pretty effects may be obtained. Endless modifications of these may be made, as a strip of glass with round bits of tinfoil gummed on in any pattern, near each other. The sparks may be coloured by placing over the glass bits of gelatine taken off "crackers."

'DISCHARGING RODS.

'Choose a rather thin and long bottle, one that will form a nice handle. Put a hard cork into its mouth, and through it put a copper wire bent into a half circle. This wire must be tightly fastened with thin wire to the cork, to prevent its slipping. On to the ends of the wire are put oak-balls covered with tinfoil. The wire being copper will bend to suit any sized jar.

'Fig. vi. represents a pair thus made, which answered very well.

‘BELL JAR FOR PITH FIGURES, ETC.

‘The object of this piece of apparatus is to show the attraction and repulsion of light bodies when electrified. Pith figures made slightly heavier at the bottom dance in a very amusing and grotesque way. The pith from the stems of old artichoke plants will be found very good for this purpose and easy to get. It should be warmed till quite dry and then cut out with a very sharp penknife. The several parts of the figures may be gummed together. Pith balls should also be made for this experiment and for numerous other pieces of apparatus. In Fig. vii. O is the end of the conductor. The bell jar P is one of the glass shades used for candlesticks, inverted. The top is closed with a cork, through which runs a wire terminating in one of our tinfoiled oak-balls. To the other end is fastened a circular disc of cardboard covered with tinfoil, a pith ball covering the extreme point to prevent loss of electricity. Thus the disc Q can be raised or lowered. The glass must be thoroughly warmed and then placed on a sheet of tinfoil, having on it the pith figures, &c., which are to dance. On placing the knob in contact with that on the conductor and working the machine the figures will dance vigorously.

‘THE ELECTRICAL PISTOL.

‘The object of the electrical pistol is to show the power of an electric spark to explode a mixture of oxygen and hydrogen in the proportion 1 to 2 volumes.

‘R (Fig. viii.) is a tin tube fitting on to the handle T, which is the end of an old walking-stick. S is a glass tube going through a hole in the tin barrel, and through it runs a wire, the outside end of which terminates in a small lead bullet. The other end reaches to within ⅛ of an inch of the inside of the tin barrel, and must not be pointed. The experiment is performed thus. Fill the barrel with the mixture of oxygen and hydrogen and cork it up tightly, then pass sparks from the conductor to the lead bullet. These sparks will be reproduced at the end of the wire inside the barrel and go to the tin, and the gases will explode, blowing out the cork to a considerable distance.

'We have often done this with a mixture of coal-gas and air, by holding the tube downwards over a gas burner, and allowing it to be partly filled with gas. Several, and sometimes many, tries are required before success comes, but we have often by practice made it go off several times in succession.'

MEETING HELD APRIL 8:—*Donations:* Corals from the Carboniferous Limestone, by Mr. S. G. Perceval: Minerals from Devon and Somerset, by Mr. R. Wheeler.

The following Paper, by C. M. Kerr (present Rugbeian), was then communicated by Mr. Wilson:—

'AN EXCURSION OF MR. WILSON'S GEOLOGICAL CLASS TO MOUNT SORREL.

'Mount Sorrel is situated about 8 miles N. W. of Leicester, and consists of granite, or more strictly speaking syenite. On approaching the S. W. side there is a section exposed, close to the church, shewing the joints admirably. On ascending the hill on that side, about 100 yards east of the church, the granite is again exposed and shews glacial markings, ranging generally E. and W. We examined the surface soil, wherever exposed, for drift; and all the way up the sides, as well as on the very top, small glacial flints were to be found. The rest of the soil was wholly composed of disintegrated syenite. It is striking that this atmospheric soil, as it may be called, should be so thick; it proves that the surface of the syenite is being broken up by atmospheric agency; and it plainly divides into sand, grains of quartz, and felspathic soil. Specimens of syenite in all stages of disintegration were easily found in an excavation about 8 feet deep near the windmill.

'To the N. a section has been recently exposed consisting of the red marl which surrounds Mount Sorrel, lying on an incline away from the hill, and above it a layer, about 2 feet thick, of glacial drift, containing abundant chalk pebbles well striated. The matrix is a sticky brown clay, very closely resembling the glacial drift in the Rugby Pit, and elsewhere in our neighbourhood. There is also, a little further east, another drift, consisting of a reformation of red sandstone, passing into a reformation of lias: it contained pebbles, nodules, and fossils of various ages, some of them striated. Opposite this section is a slope of syenite from which the surface soil has been removed, shewing fresh striation, and all rounded and moulded by ice.

'While we were there the workmen were preparing to blast a portion of this cliff: a hole having been drilled, 35lbs. of powder were put in. We retired to a sufficiently safe distance, and watched the result. The fuse was lighted, and after a lapse of 3½ minutes the whole mass was thrown in huge blocks to the bottom of the slope.

'After this we went into the quarry, and examined the machines for breaking up granite. Two great jaws consisting of iron blocks, grooved downwards, and nearer together at the base than at the top, received the blocks of granite as they were shovelled in and crushed them. The wear of these jaws is so great that they only last about a fortnight: all the while the machinery keeps up a deafening roar. The blocks of granite after the pounding fall into a long cylinder, revolving on an oblique axis, with small holes at the top through which the dust falls, then holes a little larger for the pebbles for gravel walks, then holes larger still for the stones for road mending. These fall through the revolving sieve into trucks in which they are borne to their various destinations. The whole of the machine house and the machinery is covered by a thick layer of fine white dust, which would perhaps make very good material for pottery and china. All blocks required of a particular form, for curb stones, paving, &c., are cut by hand.

'Mr. Hamblyn, the manager of the works, then took us all on an engine, and we ran down the straight private line to Barrow, standing about all over the engine, and holding on as best we could. There we examined a cutting in the lias, just at its base above the Rhætic beds. On the line we noticed a block of slate such as is found at Swithland. We also, on our return, stopped our engine in order to go and examine a limestone quarry. The partings between the beds of limestone consist of beds of the most finely laminated shale.

'We then whizzed up the line to the granite quarry once more, and examined the junction of the red sandstone and the syenite. It was very well exposed: the red sandstone rests on the granite, its dip being steeper nearer the hill, while amongst it were occasional water-worn boulders of granite, round which the sandstone was deposited when Mount Sorrel was an island.

'In the face of the cliff below the windmill is what appears to be a vein, or it might be an interstratified mass, of a bluish syenite, more like basalt, which is used for the same purposes as the granite, and is preferred by some persons. It seemed to dip W. N. W. at a high angle, and in some parts was sharply defined; but elsewhere not so. One great mass we saw, by its position part of the vein, but by its structure and colour belonging to the general syenite. Here also were grains of iron pyrites in veins in the syenite.

'Then we went to the Rectory, where we enjoyed a wash and a dinner, thanks to the hospitality of the Rector; and then by our omnibus to Leicester, and thence after spending a very happy day by train to Rugby.

'The thanks of our whole party, 14 in all, are due to Mr. Hamblyn and his foreman, who shewed us everything that could be seen in the time; and especially to Mr. Gillson, of Rugby, son of the Rector, who arranged the whole excursion, and thereby gave us no small pleasure and profit.'

W. B. Lowe (member) then read a Paper on the '*Manufacture of White Lead*,' producing specimens of the pots used and the lead in various stages.

The President then read a Paper lately published by M. H. Bloxam, Esq., on the Bottle found at Lawford, and exhibited last year to the Society.

The President then read a Paper on the '*Geographical Distribution of the Sequoia, or Wellingtonia*,' and gave an account of Professor A. Gray's views on the subject.

MEETING HELD MAY 24:—*Exhibitions:* Stamenless form of Ground Ivy from the Barby Road, by the President; Living Corals, by Rev. T. N. Hutchinson; Two Photographs of Sequoia gigantea, and Collection of Photographs of the Yosemite Valley, California, lent by Mr. Power. *Donation:* Case of Insects from Geneva, by Mr. Melly (O. R.)

G. L. King read a Paper on '*Gun Cotton.*'

Mr. Wilson then read the following Paper on '*The Rugby Drift,*' and exhibited a series of fossils from the L. and N. W. Railway, near the Clifton Road Bridge:—

'On April 10, 1873, and some following days, I visited the cutting of the L. and N. W. Railway between the station and the Clifton Road. Between the two bridges the line was being widened on the east side, so as to admit of a fourth line of rails. The east side was exposed for about 200 yards on both sides of the bridge nearest the station. At the northern end the undisturbed lias clay was exposed to about the depth of 4 feet, and was covered by brown clay and sand containing various water-worn pebbles. At the bridge the surface of the lias is about 2 feet above the line, and it sinks to the level of the line just south of the bridge.

'From this lias I obtained a series of Ammonites, which I exhibit, and which are, I believe, A. Brookii, and A. Birchii.

'The whole face of the cutting is therefore in the drift, and it is on this that a few remarks ought to be made, as it may be long before it is again exposed.

'Immediately resting on the lias is a bed of from 10 to 12 inches of dark brown greasy clay, very full of small chalk pebbles; then came from 3 to 5 feet of brown greasy clay, with very little chalk and no pebbles, or very few; over all was a drier, sandier brown clay with pebbles of the so-called northern drift—*i.e*, of quartzite, containing often pockets or instratified patches of sand finely stratified. In it there are abundantly to be found striated chalk pebbles, and flints, mixed with blocks of red marl and sandstone. At the top of all, but without any decided line of separation, is the so-called northern drift, consisting of sand and gravel, with abundant flints and quartzite pebbles.

'The examination of this section has suggested to me as probable what has been floating about in my mind for some years as a hypothesis on which to observe these perplexing drifts. A reference to pp. 27—31 of the Society's Report for 1868 will shew how far this hypothesis is a modification of the views I then entertained. It seems possible that what we have been calling the northern drift, and separating from the glacial drift in origin, and in time, and in mode of deposit, may be only a later member of the glacial drift and very intimately connected with it. After the surface of this part of the country had assumed its present general outline of hill and valley, after its drainage system had been established, by the combined action of sea and river and rain, it seems to have began to sink to u the sea level once more. The soft clayey shores easily yielded to the waves in the estuaries, and a shore deposit was formed of which the main ingredients were derived from the clays in the immediate vicinity. But the presence of chalk pebbles in this deposit shews that some agency was conveying it hither from the east or north-east. I do not know how far to the west this drift extends. It is found abundantly here just below the crests of the hills, down to perhaps 310 feet above the sea. It certainly extends northward as far as Mount Sorrel, for our geological excursionists saw it exposed on the northern flank of Mount Sorrel to great perfection last Term, and it was precisely like what we are here so familiar with. I conceive this to have been effected by floating ice of no great mass. The perplexity to me is that we are on the west of the watershed, and I see no gap through which the floating ice would readily pass. Some such gap may then have existed and now be stopped up by drift, and there are other circumstances which render this a not unlikely solution of the difficulty. As the land sank further it ceased to supply so exclusively the materials for the deposits that covered it. Hence the clays that rest on these blue drift clays are more varied and generally brown. They contain admixtures of sand, and sometimes the sand is very pure. These brown clays and this sand seems very plainly derived from the trias marls and sandstones which lie north and north-west of us. The direction of the drift then must have been shifted a few points, or gone round from N. E. to N. or thereabouts. Still, however, chalk blocks are found in this, and large oolitic blocks and pieces of upper lias, mixed with blocks of sandstone of triassic origin. All this indicates an origin N. N. E. of Rugby, from which alone this mixture could be obtained. Here too we begin to find the well-worn and extremely hard pebbles of quartzite, varying from almost transparent quartz to dark liver colour crystalline quartzite, which is, in fact, a metamorphosed grit. And higher up we find these and the flints mixed together in varying proportions, and forming what is called the northern drift. This seems to me now to be only another stage of the glacial drift. The country had sunk still further, and stones, which now floated over it on ice, or were drifted by currents, were brought from greater distances; and these water-worn pebbles were derived from the lower trias or bunter beds, somewhere to the north of us at a considerable distance. In these bunter beds is a deposit of loose conglomerate of such pebbles, so that the rolling and rounding of them must be referred not to the glacial age but to one far preceding it, dating back to the beginning of the secondary age. They are an old shore deposit, a pebbly beach of triassic age, never completely compacted, and now dispersed over this part of the country in the gravel. The character of the pebbles generally confirms this view, and this general view seems to me to explain many things which have been perplexing:—these vast accumulations of drift sand at Hillmorton, at Harborough, in Rugby, and elsewhere. It seemed impossible to assign them a place in the series; they graduate, in fact, without a break into the pebble drift above, and the chalk and lias drift below.

'There seem to me therefore now some grounds for believing that our general drift here is not divisible at all, but is the result of one continuous process performed while the land was sinking, the materials at first being derived from the immediate neighbourhood, and afterwards from greater and greater distances. The sands would be separated from the rest by the action of the currents, and it is to them we must look for the cause of such deposits of sand and clay as are mentioned above.*

'I have stated the hypothesis that these water-worn pebbles are the remains of the bunter conglomerate. But I am not acquainted with this conglomerate *in situ*, and know of it only from books; and it is fair to mention one or two facts that conflict with this. The stones that form it may, to a considerable extent, have come from the eastern side of the Warwickshire coal-field about Hartshill, the character of the stones being not at all dissimilar, and they may therefore come hither not ice-borne but simply rolled. The great mass of stones that form the drift at Hartshill are plainly derived from the immediate neighbourhood, and are not rolled but angular and imbedded in triassic sand. It requires further examination to ascertain how far these angular and rounded stones graduate into one another. The effect of this modification of my view is not great; it only has the effect of deriving the pebbles from a nearer source still than the one assigned above.

'Some members of the Society have asked me what they can do by way of useful study and work in the drifts. I will suggest one or two things that only require a moderate knowledge of rocks, and some patience. (1) To observe and give *written* descriptions of the drift wherever exposed, describing the amounts of sand, of clay, of rolled and angular stones, with any remarks on the striation of the stones or the absence of it, and on their origin. (2) In the gravel to compute a few percentages of flint and quartzite, as to number, and approximately as to bulk, taking care to select average localities in each pit. (3) To extend their observations, as far as time and legs will carry them, into the neighbourhood of Rugby.'

---

* The oolite drift of Brownsover is certainly perplexing: I have already described it to the Society; and all that can be said of it here is that it underlies the pebble drift, and seems, therefore, to correspond to the middle portion of the general drift. It is not exposed anywhere to its base, and not sufficiently known as to its extent to enable me to speak positively about it.

MEETING HELD JUNE 7:—*Donation:* Collection of Economic Plants, by Rev. A. Bloxam. *Exhibitions:* Vertebræ of large Icthyosaurus, from Victoria Lime Works; Upper Lias Shells, from Drift of Mount Sorrel, by Mr. Wilson; Ammonites Conybeari, by F. Arnold; Primrose, shewing two storeys of peduncles, by the President; Mamestra Persicariæ, bred in 1873, by Mr. S. Haslam; Grass growing through a Stick, by H. W. Trott.

H. W. Trott then read an '*Account of an Expedition of the Botanical Section to Princethorpe.*'

'On Monday, May the 19th, the Botanical Section had an expedition to Princethorpe—a village on the red sandstone beyond Frankton, about 7 miles distant. On arriving at the Princethorpe Wood we found the Orobus tuberosus (a Peaflower not to be found within the five-mile radius) and several Grasses and Sedges, amongst which were Melica uniflora and Carex sylvatica; and lastly, the great Starwort (Stellaria holostea), a few specimens of which were found to be attacked by the fungus, Ustilago antherarum, so called because it is found on the *anthers* of certain flowers. Leaving Princethorpe Wood behind us, we set out on our return to Rugby. We did not forget to pay a short visit to Frankton Wood, but did not expect to find it so destitute of flowers as it then was; though no doubt later in the season it will reward the botanist for his trouble. Having passed through the wood, we found the Helmet Orchis in bud, and close by the leaf of the Adder's-tongue Fern just appearing above the ground. We then continued our walk, arriving at Rugby about 7.30.

'The variety of fungus which I mentioned above (the Ustilago antherarum) attacks the Silene and red and white Lychnis as well as the Starwort, all of which belong to the Pink family. The different varieties of Ustilago attack chiefly the Grasses, Sedges, and Pinks. The spores (or reproductive cells) of the Ustilago are simple, springing from delicate threads, or produced in the form of closely-packed cells, which ultimately break up into a black powdery mass, as is the case here. This fungus is much the same in appearance as the mildew of wheat or Puccinia graminis, though it differs somewhat from it in form.'

W. B. Lowe then read the following Paper on '*Cohesion of Water at various Temperatures.*'

'The following experiments were suggested by a remark made in one of Mr. Wilson's lectures on heat on the continuity of the states of matter. It occurred to us to examine whether the degree of fluidity of water varied at different temperatures, and we intended to try it especially at temperatures very near 0°C. These experiments were, however, unavoidably interrupted, and we are obliged to offer them in an unfinished condition to the Society. They cannot be resumed, as their value depends on the identity of the apparatus used throughout.

'Our method was to allow water at different temperatures to drop slowly from a pipette with a glass stopper, and to count the number of drops that went to 100c.c. The following table of results obtained by W. B. Lowe will be intelligible at a glance.

'It must be admitted that some precautions were not adopted that must be observed in repeating these experiments, if any one should think it worth while; we did not observe them, as we regarded them as preliminary only. It is plain that the temperature of the air, the degree of moisture of the air, and the pressure of the barometer, ought to have been observed in order to make the results accurate.

'But it is probable that the corrections which would follow from these observations, even if they could be computed, would not affect the general result, which is, that *the magnitude of a drop, ceteris paribus, steadily diminishes as the temperature rises.*

Volume in c.c. of 100 *Drops of Water at Different Temperatures between* 40°*F and* 150°*F.*

Number of Drops.		Vol. in c.c.		Temperature.
100	=	4.62	at	41°F
100	=	4.62	„	42°

Number of Drops.		Vol. in c.c.		Temperature.
100	=	4.62	at	44°F
100	=	4.69	„	41°
100	=	4.62	„	45°
100	=	4.62	„	43°
100	=	4.627	„	42°
100	=	4.62	„	42°

And the Average of these 8 *Experiments gives*

100	=	4.629	at	42°5F

100	=	4.606	at	50°F
100	=	4.613	„	51°
100	=	4.55	„	50°
100	=	4.55	„	52°
100	=	4.55	„	52°
100	=	4.606	„	50°
100	=	4.62	„	50°
100	=	4.606	„	50°
100	=	4.606	„	50°
100	=	4.606	„	50°
∴100	=	4.5913	at	50°.5F

100	=	4.55	at	60°F
100	=	4.62	„	60°
100	=	4.55	„	60°
100	=	4.536	„	60°
100	=	4.62	„	60°
100	=	4.62	„	60°
100	=	4.55	„	60°
∴100	=	4.578	at	60°F

100	=	4.48	at	80°F
100	=	4.473	„	85°
100	=	4.494	„	82°
100	=	4.41	„	80°
100	=	4.48	„	80°
∴100	=	4.4674	at	81°.4F

Number of Drops.		Vol. in c.c.		Temperature
100	=	4.41	at	100°F
100	=	4.41	,,	100°
100	=	4.41	,,	100°
100	=	4.396	,,	100°
100	=	4.34	,,	100°
100	=	4.34	,,	100°
100	=	4.41	,,	100°
100	=	4.41	,,	100°
∴100	=	4.3908	at	100°F
100	=	4.41	at	120°F
100	=	4.41	,,	120°
100	=	4.382	,,	120°
100	=	4.396	,,	120°
100	=	4.347	,,	120°
100	=	4.34	,,	120°
100	=	4.396	,,	120°
∴100	=	4.383	at	120°F
100	=	4.34	at	130°F
100	=	4.347	,,	130°
100	=	4.357	,,	130°
100	=	4.396	,,	130°
100	=	4.34	,,	130°
100	=	4.284	,,	130°
∴100	=	4.3425	at	130°F
100	=	4.284	at	140°F
100	=	4.326	,,	140°
100	=	4.34	,,	140°
100	=	4.284	,,	140°
∴100	=	4.3085	at	140°F

The President then explained a chart of flowering dates for 1872, as compared with temperature and rainfall.

B. R. Wise (member) read a Paper on the '*Australian*

Fauna,' describing the Dingo, the Bat, the Opossum, the Flying Squirrel, and the Flying Mouse.

MEETING HELD JUNE 21 :—*Donations :* Boar's Teeth from India, by R. D. Oldham; Orobanche minor (new to the Flora), by Rev. A. Bloxam. *Exhibitions :* Series of the rarer Kentish Orchids, from Dorking, and Tubers of Figwort Buttercup growing in the axils of leaves, by the President; Pelorian forms of Calceolaria, by L. Knowles.

The Rev. C. J. E. Smith (hon. member) read the following Paper on a '*Foxglove,*' then in flower in his garden.

'ABNORMAL FLOWER OF FOXGLOVE.

'The flowers of Foxglove are generally developed laterally upon the tall stem of the plant, each flower-stalk growing in the axil of a leaf, but bending across the stem so as to hang upon the side opposite the leaf; that which is, botanically speaking, the uppermost petal, becoming thereby the lowest in position (as happens in Orchids), and affording a convenient landing for the humble-bees which revel in this flower. The inflorescence is *indeterminate,* and there is no terminal bud whatever.

'About a fortnight ago, however, I observed a terminal bud beginning to develope at what would generally be about half the natural height of the stem. It was then unopened, but it was easy to see three or four petaloid leaves amidst a thick mass of small ordinary leaves, which played the part of a very irregular calyx or involucre to the flower.

'There were 13 stamens and a large ovary formed of several coarse carpellary leaves, each with a thick style, the whole having the appearance of a bottle standing up in the centre of the flower. Not knowing how far it might get developed I got a photograph taken of it (this was kindly done by H. N. Hutchinson). See Fig. i., Plate II. A few days after a second photograph was taken, the flower having opened

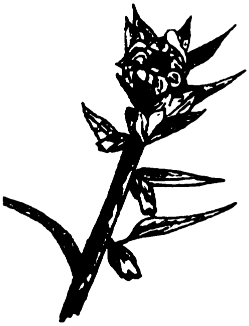


Fig 1.

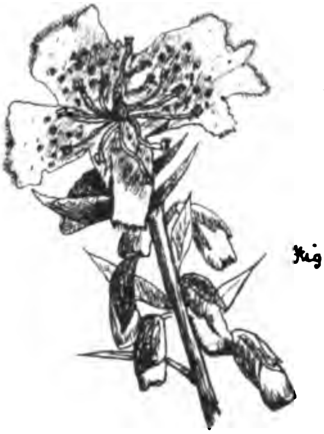
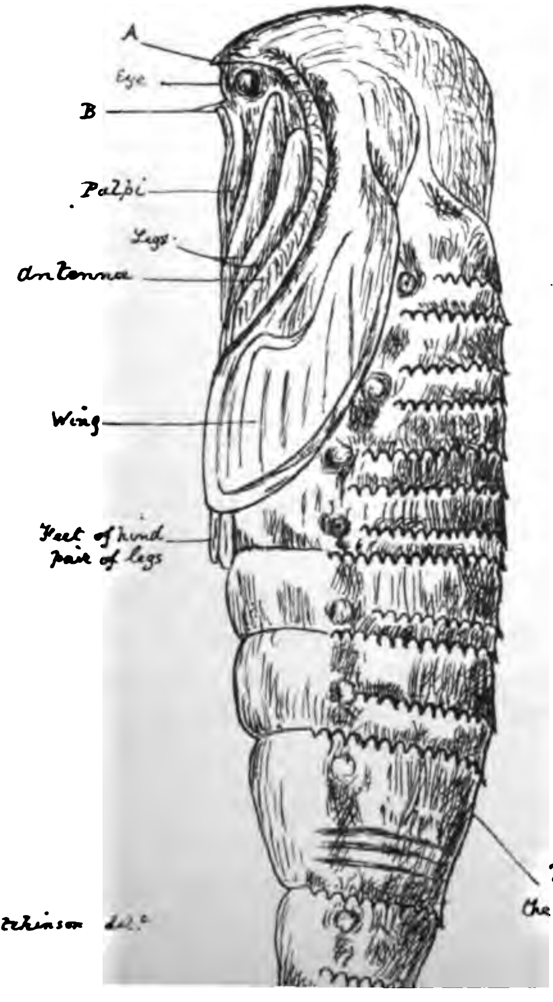


Fig 2.



Real size of pupa.

N. Hutchinson del.

a good deal more; and to-day a third has been taken (see Fig. ii., Plate II). The flower is now fully developed, about 4 inches across; the petals, which are joined together for some distance around the base, lie completely back, spread out as far as they can stretch. They are spotted all over in the way in which the large or uppermost petal in Foxglove usually is; they are in four divisions, each shewing at the end the outline of two or more lobes. The impression given is that of the materials of three or four corollas clubbed together to form one. The 13 stamens point to the same conclusion. To-day the stamens have begun to develope pollen.

'There does not seem to be any prospect of a development of stigmatic surfaces; but as the stigma is the last part of Foxglove to come to maturity, it is worth while to wait some days longer.

'There are about a dozen proper flowers on the same stem below the monster; they are opening in the usual order—namely, the lowest first; but the monster took precedence of all. As the stem is cut short by the abnormal growth at half its usual height, it is natural to expect that the side branches, which spring from near the base of the stem, will grow more than they usually do. There are two such, with some flowers on each, and I suspect that each of them is going to develope a terminal bud similar to the one I have described upon the main stem.

'If so, those who have not yet seen this plant will have an opportunity of seeing the entire growth from beginning to end.'

Mr. Wilson then gave an account of a visit lately made by him to the Clapham Cave, near Ingleborough, and the Weathercote Cave and Victoria Cave, near Settle, Yorkshire, and illustrated his remarks by photographs and specimens.

The following Paper, by E. Mann (present Rugbeian), on a '*Geological Expedition to Atherstone and Nuneaton*,' was then read.

'Last Monday, June 9th, Mr. Wilson took several fellows of his geological set, and of the geological section, on an expedition to visit some quarries and a coal mine, near Atherstone. The party started from Rugby at 2.15 by rail, and arrived at Atherstone about 3 p.m. The town of Atherstone consists of one long street; it is a quaint old place, but has one or two handsome new buildings in it. The first place the party visited was the kennels, where the Atherstone hounds are kept. There are 60 couples of trained dogs there, kept beautifully clean and tidy. They did not stop there long, for geology called them, and there was no time to waste. The next place they visited was a quarry, where the millstone grit is worked. The face of stone visible is about thirty feet high. It dips west at an angle of about 30°. The rock has been highly metamorphosed by greenstone, which is intrusive within the strata. This rock is very largely used for roads. Passing on from here they went along a ridge of hills which rises about 150 feet above the plain, and is caused by a fault which has thrown down the coal on the east. From this ridge, on a fine day, an excellent view is obtained of the country round, even as far as Mount Sorrel. After walking about four miles they came to the Hartshill quarries, which is the only place where the greenstone is visible, in actual contact with the grit, in this neighbourhood. Here was seen to perfection how the greenstone was forced in between the strata, as the rock above was burnt quite black and was exceedingly brittle. It is even more burnt than that below, in some places. A vein of crystallized quartz was here visible running through the rock in one place. From here they walked on to Stockingford, a little village near Nuneaton, where the coal pit they were going to explore was situated. There was some little delay before going down the pit, as the foreman had to be sought and miners' coats had to be fetched. In the meantime one of the party, picking about on the beds of shale, round the pit-mouth, found a piece of sigillaria, the fossilized stem of a tree. These are not very often found here, and so it is worthy of note. One of the colliers said they sometimes found marks, like the print of hobnails, on the coal, which is not a bad description of the sigillaria.

'It was now time to go down the pit, and so the party prepared, by taking off their coats and hats and leaving them above, and as many as could got miners' coats and strong hats to protect the head if it struck the roof. They had to go down in parties, as the cage would not hold them all at once. When they arrived at the bottom of the shaft, at first they could see nothing, but as their eyes got accustomed to the darkness, which was absolute except for the faint glimmer of a few farthing candles, they began to peer about. The first thing that drew their attention was the trucks, which are made up of trays, made by broad iron bands which are moveable, so that when the passages are low some of them can be taken off. Preceded by the foreman, and followed by two other colliers to see that none of the party got lost, they picked their way through passages, which were too low to be at all pleasant to walk in. After scrambling along some distance they came to a place where the roof had fallen in, and was being propped up with wooden posts. A little further on the guide stopped suddenly, and told them he thought he heard the roof coming in a little further on. They stopped to listen, but could not hear anything as the number of the party was too large to get absolute quiet. However it was not thought advisable to go further, so they turned back and went down another passage. Here in one place was a band of clay between the layers of coal. A little further on there was a place at which the floor had been squeezed up to meet the roof. After seeing this they retraced their steps, and went to see the furnace which draws air through the workings where the men are. As there was nothing more to see they went up again, and after a wash, which was much needed, they went to see the place where the coal crops out. They saw one spot where the coal had been actually worked at the surface without any shaft or tunnel. In another place close by there are two tunnels which go into the ground following the strata, but which are now disused. At one of these the coal can be seen quite plainly, dipping at an angle of about 50°. Clay iron ore is worked at the same place, but it is sent away to be smelted. From here they turned their steps to Nuneaton, and arrived there in good time for a train at 8 p.m., which reached Rugby at about 8.40. The day could not have been more favourable, and I am quite sure that, without exception, all the party enjoyed themselves exceedingly.'

Mr. Sidgwick (hon. member) then read the following '*Experiments on Ants.*'

'In the last few days I have been observing a small colony of ants in my garden.

'They are established under some ivy which abuts on a path, and they have occasion (for social, commercial, or political purposes, I don't know which) to cross this path to the scene of action on the other side. I have not examined where they come from, or where they go to; and the only point I have been observing is their mode of action across the path.

'The first glance would lead one to suppose they are wandering aimlessly: but only the first glance. They never run straight for more than a short way; then comes a slight swerve to the right or left, with much action of the antennae: then another little run, and then another swerve; and so on. It is this constant slight swerving which gives the first air of aimlessness; but a very little watching shews that their swerving is within narrow limits, not more than an inch at most, and rarely so much; and that their general direction is very straight.

'How do they find their way?

'Not by sight, clearly: for they would not have to swerve at all.

'I tried two small experiments to solve this, both with results which were amusing and interesting.

'On Thursday I waited till a part of the track was clear of ants, so that they might not see my manœuvres; and then with a sudden sweep I drew my two fingers across their path, not removing any stones, but only sweeping off particles of dust and grit, and making the road a little rougher, certainly not so as to form any obstacle to an ant.

'Up they come, trotting and swerving at a good pace.

Then the front one reaches the part where my finger had been. Stops dead. Trots off to the right, stops again, trots off to the left, back and forward, round and about: only across those finger-marks he will not go. Meanwhile his antennae are going at a frightful rate. Soon he is joined by another. Same manœuvre. Then another. At last there is a crowd on each side of the imaginary barrier, no one daring to cross. Ultimately a daring spirit goes over, finds his friends on the other side, speaks a friendly word, and goes contentedly home. Soon he is followed by another; but it was a long time—I should think an hour—before they seemed quite comfortable in crossing the place.

'On Friday morning I waited again till there were no passengers in sight, and then blew a puff of the smoke of—a fragrant, but strong smelling herb—across the path. Exactly the same effect was produced. Long after the smoke was quite vanished (to human eyes) the ants came up to the place, stopped, felt about, went back, came up again, and, in short, were completely bewildered.

'I especially noticed that in this case they were not the least like insects running away from smoke—[*they* would scamper straight off in a fright]—but they were simply baffled by it.

'The facts seem to me to point to *smell* being the sense which guided them. The first experiment might point to touch, but the second could not.

'Perhaps some member of the Natural History Society can throw light upon the point. It is in this hope I have written this note.'

The President called attention to a similar observation by Mr. Hague, of California, recorded in a recent number of 'Nature.'

MEETING HELD JULY 5:—*Exhibition*:—Cardamine impatiens, from Harborough Magna, by Rev. A.

Bloxam; Eggs and Five Stages of the Caterpillar of the Puss Moth, by A. J. Solly.

C. M. Chadwick made some remarks on the fact that the Chickens of the Rev. C. T. Arnold had been eaten up by Rooks, and reported that other similar cases are on record whenever Rooks are hard pressed for food.

The following account of an '*Entomological Expedition to Frankton Wood on June 17th*,' by H. A. Bull, was then read:—

'It had been settled for the Entomological Section to have a field day in connection with one which the Uppingham Entomological Section was going to make in a wood near that place. The day before was, however, so very unpropitious that it was deemed expedient, owing to the quantity of rain which had fallen, not to go. It is needless to say that every one was much disappointed; the only thing was to wish for better luck next time. Let us hope that the next time the Entomological Section is going to make an expedition that the then head of the school will be more successful in his attempt to keep up the school barometer—that is to say, if he happen to be serving on the meteorological staff. This time, although he had received most strict injunctions from Mr. Sidgwick "to be sure and have the glass high and steady," he signally failed, and the consequence was that on the day before the glass stood at its lowest point so far this Term. It was in this way that we did not go to Uppingham, but at ten o'clock the day cleared up so well that Mr. Sidgwick determined "to collect his shattered forces" and try his luck at Frankton instead. Accordingly, we started by the train at 12.30 and arrived there, happily without any accident, at 12.45. We then began to set to work, and the first capture was an oak eggar caterpillar, by Vicars; then Mr. Sidgwick found some caterpillars in the catkins of a sallow bush, and two of us spent some time in looking for more. Nothing much, however, turned up till we reached the wood, but when there we began to catch things at once. They were mostly geometræ till some one turned up a "Euphrosyne" or two—that means, in plain English, "A large pearl-bordered Fritillary," but the initiated will understand what it was by its shorter name, which was probably given it because it was like *something*—but no one knows exactly what. After tramping about the wood a considerable time I turned up a moth called "Heliodes arbuti," of which we took a considerable number altogether. They fly about in long grass, and are extremely hard to see.

'Mr. Sidgwick then took a very good geometer, one of the carpets, which went by the plain and simple name of Cidaria silaceata. However it is new to the list, which is a good thing, and Mr. Sidgwick is to be congratulated for his great dexterity in adding it to his other captures.

'We tried beating for caterpillars into an inverted umbrella, but it was no use; and after a few more insignificant captures—amongst which Solly took a very worn pudibunda, laying its eggs—we turned our steps to the station. It began to rain pretty heavily, but we managed to survive and got home again without accident, though in rather a moist condition.'

The President then read a note on '*Teesdalia nudicaulis.*'

'One fact—properly belonging to the Botanical Section—may be of sufficient interest to be brought before the Society.

'We had growing in the Hillmorton Road a little crucifer, Teesdalia nudicaulis, found in 50 per cent. of the counties, and 16 out of 18 provinces—yet *rare.*

'Hardly recorded anywhere else in the county, except only the Lower Hillmorton Road.

'The last time I found it growing was in 1871.

'In 1872 I did not see it, but J. Armitage found it.

'This year I have looked for it in vain, and it seems to have been driven out by the grass and coarser herbs. A regular struggle for existence has been going on. The poor Teesdalia seedling has failed in the struggle: its old comrades, the Many-coloured Forget-me-Not, the Whitlow Grass, still survive, but the little plant is no more to be found.

'Many plants of Rugby have died out in the memory of man. The Radiola millegrana, Peplis portula, the Mountain Fern, are historical memoirs of the past.

'The Heart's Tongue and Hard Fern, the Foxglove and Golden Rod, in the memory of man known to have been common, are now our rarer plants.

'But as far as I know this is the first old inhabitant which has died away in our time, or since the Society came into existence.

'I may have made a mistake—I only hope I have; for I do not wish to lose the flower; but I have visited the spot 6 times fruitlessly—last Term in the Easter holidays, and again twice this Term, and have not found a single plant, where in 1869 and 1870 I found *thousands.*'

The Rev. T. N. Hutchinson informed the Society of the death of the two Hippocampi, whose portraits were given in the Report for 1872. They died for want of food, as soon as the time of year came at which oysters ceased to be procurable. Sandhoppers were offered them, but without success.

MEETING HELD OCT. 4:—*Donation:* Pair of Laplander's Shoes, by A. W. L. Boyd. Collection of Snakes, etc., sent from Rosario, by N. Larden (O. R.), corresponding member.

Rev. T. N. Hutchinson then exhibited and described 25 Models of Foraminifera, magnified, and Casts of several celebrated Meteorites.

L. Knowles (associate) then read a Paper on '*Coal,*' illustrated by a Box of Specimens.

MEETING HELD OCT. 18:—The Report of the Prize Committee was read, to the effect that, in the competition of Essays embodying original work on any scientific subject, no first prize had been awarded, but that equal second prizes were to be given to L. Knowles for an Essay on Coal, and V. H. Veley for an Essay on the Cross-fertilization of Plants.

The Essay by V. H. Veley (associate) was then read.

A Paper, by W. B. Lowe (member), on a '*Tour in North Wales*,' was then read.

MEETING HELD NOV. 1:—*Donations:* 18 Specimens of British Marine Animals caught off the West Coast of England, and preserved by C. M. Chadwick (member). Set of Eggs of Scotch Birds, by F. Sykes.

The President commented on the goodness of the Four Collections of Plants sent up for the Holiday Collecting Prize. Some of the rarer specimens were then exhibited.

J. S. Beuttler (associate) read the following Paper on '*The Habits of the Chameleon.*'

'The Chameleon is the most interesting of the Saurian tribe, and inhabits Asia, Africa, and even Southern Europe, as a hot moist atmosphere seems most congenial to it. First, I will say a few words as regards its structure. It has a compressed body, flattened to an edge at the back, and covered with small scales. Its tail is capable of bearing the whole weight of the body, and of turning round objects and grasping them. The five toes of each foot are divided into two sets of three and two respectively. Each set being united with a skin as far as the nails, and being placed in opposition to each other, resembles the foot of a parrot. The ears cannot be seen, as they are concealed under the skin. The eyes are of singular beauty, each eye moving independently of the other, as if on swivels; while one looks backwards, the other can be directed forwards and upwards. They are covered with a thick skin, leaving only the pupil exposed. Its tongue is very peculiarly constructed, consisting of a long tube-like cylinder, with a lump at the end, resembling an acorn with its cup cut in two. This is covered with an adhesive saliva, to which its prey adheres. The tongue when at rest is contracted, like a telescope, and lies in the bay-like cavity of the mouth. When the Chameleon is irritated it opens its mouth with a hissing noise, when the tongue may be seen in this position. The whole inside of the mouth, as well as the tongue, is of the bright yellow of a ripe apricot. The usual colour of the Chameleon is a light yellowish green, which changes into a dark blue or brownish green, with spots of a prominent red or purple. When irritated it turns into a dark green or black. The change of colour is thought to be produced by the inflation or contraction of its enormous lungs, which force the blood to the surface of the body, contrary to what might be expected. The side of the animal nearest the light is invariably the darkest. The home of the Chameleon is on low shrubs, where its movements are exceedingly sluggish while passing from one branch to another. First raising one foot very cautiously, it will remain in this position for a considerable time; then it moves the foot slowly forward and takes a good grasp of the branch it wishes to reach, and when it has got a firm footing it unwinds its tail, shifts it forward, and recoils it. The Chameleon feeds principally on flies and other small insects, which it catches by swiftly projecting its tongue, then, having drawn the victim into its mouth, it coolly masticates it, quite careless of the poor fly's struggles. Food need not often be given; in fact, it can live for months without taking any; and this has given rise to the popular idea that it lives on air.

'My first Chameleon, which I have here by me in pickle, came from the Cape of Good Hope about four years ago. On its arrival I bought an Oleander tree, on which it soon got to be at home, and as a rule you always found it on that part which faced the window, but as night came on it retreated towards the centre of the tree. Whenever the tassel of the blind was within reach of the plant it would make frantic attempts to get on it, and when it reached it, it would climb to the frame of the window and rush backwards and forwards, clawing and beating its head along the glass. We were for some time puzzled to know what this could mean, until we saw one day that it was his shadow that he was so eager to fight. However, as a rule, it was of a most gentle and quiet disposition, and eventually grew to be quite tame, taking flies from our fingers and watching for them as soon as we entered the room. On the approach of winter he became torpid, and, as owing to a case of illness in the house, he was not so carefully looked after, he got lost. Months passed and we saw nothing of him. However, in spring, when the weather was getting warm again, he was found creeping out of the ash-pit, but unfortunately with his tail crushed, as we think in the ash-pit door. The part of the tail where it was broken may be plainly seen. We washed its mouth and throat, which were full of ashes, and nursed and doctored it as well as we could, but it only survived a couple of hours. It would appear that when the cold weather set in he crept into the fire-place for warmth, and got swept out and thrown away with the cinders, where there is no doubt he existed for at least six months without food of any kind.

'Several years elapsed before I could procure another. However four months ago I was lucky enough to get the one which I now exhibit. There is this striking difference between the two, that, whereas the first was most gentle and almost attachable, this one repels every advance of friendship with an angry hiss. We never knew that the former had a voice at all; this one's snarl may be heard a dozen times a day. The general opinion is that this is the lady. Soon after she came she began to shed her skin; the tail and the hind legs were the first to peel off, and the pieces of skin hanging about gave her quite a beggarly appearance; then the head; and lastly the back, where one tiny piece still remains. I have with me portions of the skin, which I picked up as they dropped off. It has a strange habit, when anyone approaches nearer than it likes, of puffing out its body with its ribs distended and inflating itself till it is almost as large again. In taking its food it is very shy, and the only way to see it dart out its tongue is to put a dead fly on a leaf and hide out of sight—when at first it seems to take no notice of it at all, but, after a few minutes, turning its head swiftly towards the leaf, it shoots out its tongue, and draws it back so quickly that unless you are watching very intently you will not be able to see it.* It assumes various positions. When at rest it lies extended along a branch, with its head upwards; sometimes it supports its body with its hind legs and tail alone, waving its front paws in the air in the same manner as a praying mantis does. In cloudy weather it never stirs; sometimes even scarcely opening its eyes the whole day; but a few hours' sunshine warms it into activity. At first we thought that it did not require any water, but one day when the tree happened to be wetted in a shower we saw the Chameleon greedily sucking the water off the leaves. Ever since we have put daily a few drops of water on the leaves, which it sucks when thirsty. If you touch one of its sides with your finger it will dart at it with its mouth wide open, as if it intended to bite, but it rarely does; however, even if it did, its bite is perfectly harmless. At night, if you carefully approach the Chameleon with a light, the eye turned towards the flame will open and move about, and the corresponding side will change colour, while the other eye will remain for some time fast closed in sleep and no change will be seen in the colouring of the body. There is no difficulty in making it change its colour at any time. For instance, in gas light it assumes a light green with an ashy white underneath. If you place it on a red ground the copper colour becomes more prominent than the green, but the most striking change is seen when it is put on anything black, for then it grows almost as black as the ground on which it is placed. When put on any flat surface it tries hard to get off, but as its claws are only made for climbing, it sprawls about in a most hopeless manner, especially if it is put on a sheet of glass. When it falls down, from the breaking of a leaf or the snapping of a bough, it never seems to hurt itself, for, like the cat, it falls on its legs. In fact, the former one fell from the balcony on to the stone steps beneath—a height,

---

* The greatest length we have ever seen it shoot out its tongue was a little over four inches.

I should think, of at least 20 feet—without any apparent injury. In feeding, it prefers the small house fly, but spits the blue bottle out of its mouth with disgust; it rejects also all those that are not alive, or at least freshly killed; two or three flies a day are quite sufficient for it. But unless it hibernates during the winter, as flies grow scarce, I am afraid that it will share the fate of the Hippocampi.'

R. D. Oldham (associate) then exhibited a superb series of 40 Photographs of Scenery in the North Punjaub.

MEETING HELD NOV. 15:—The following Paper was read by Mr. R. H. Scott, F.R.S. (O. R.), Director of the Meteorological Office, London.

'THE WEATHER.

'The state of the weather is, as is well known, the stock subject of conversation for every Englishman, and a most useful beginning is it for starting a dinner-party conversation. There is good reason for this, as we have almost the most changeable climate of any in the world. In tropical countries, where the year is divided into a wet season and a dry one, and in India especially, where the alternate monsoons bring with them each its own kind of weather for months at a time, it is usually pretty easy to form an idea of the probable character of the weather for some time beforehand; but in these islands, as I shall try to show you, it is most venturesome to attempt to predict a fine day, even for so short a time as two days in advance. In fact, it has very fairly been said that no one who has any character for wisdom to lose would ever set up as a weather prophet.

'Fishermen, gamekeepers, and shepherds, and other men who are out all day long, in all weathers, can make *for their own district* a very good guess as to the chances of weather, from local signs. From the experiences and sayings of these men the mass of weather lore, mostly in rhyme, which is current everywhere, though in various forms, has been accumulated. Such is the monkish couplet about Candlemas Day.

'"Si sol claruerit se Virgine purificante,
Majus erit frigus post festum quam fuit ante."'

'Of English sayings we have—

'"If the grass grows in January 'twill grow the worse for it all the year."'

'"A handful of March dust is worth a king's ransom."'

'"April showers
Make May flowers."'

'"A dripping June
Sets things in tune."'

'A very useful saying for any one who is fond of fishing is—

"When the mist creeps up the hill,
Fisher, out and try your skill.
When the mist begins to nod,
Fisher, then put past your rod."'

'From this very district the most important collection of these traditions has been handed down in the shape of the famous Rules of the Shepherd of Banbury.

'It is utter folly to laugh at these rules, for several of them are most valuable and useful everywhere, though the greater part are only true for each special district, and will lead us quite astray when we try to apply them in a distant part of the country.

'It must be confessed that we, with apparently the most perfect scientific machinery for recording weather at our command, must be contented to be often more at fault about coming weather, for any particular district, than many an old countryman who can barely read and write, but whose wits for weather wisdom have been sharpened by his mode of life in the open air every day, and all day long.

'This being the case, you may well ask "cui bono" the stores of observations which are made, day by day, at all the countless stations over the globe, and in England in particular. The answer is, luckily, not far to seek. It is absolutely necessary to have this information from a great many stations, in order to get an accurate record of the weather which is felt at each station, and thereby collect the materials for the study, firstly of our Climate, and secondly of our Weather.

'If we contrast Astronomical with Meteorological stations we shall soon see the difference. The astronomer is looking at the stars, and they are so far off that it makes little matter whether he is observing them from Greenwich or from Rugby; all that is wanted for an astronomical observatory is a site where you have a clear view of the sky, and where the sky itself is usually clear.

'In Meteorology the case is widely different, for the phenomena to be observed take place in our own atmosphere, and what we have to ascertain from the records is not only the actual observation taken, but how that observation differs from the same kind of observation taken at the same time—say at Oxford or Birmingham, or at any other station.

'The Meteorological observations, particularly of temperature, wind and rain, are affected by distance from the coast, by height above the sea, by the character of the country, whether hill or flat, and even by the soil itself. You will, of course, know how the barometrical observations are influenced by height above the sea and by temperature, but as corrections can be applied to the readings for these effects I have not specially noticed them.

'We may say that there are three great uses to which observations in our science can be applied.

'I. *Local Weather Study.*

'II. *Study of Local Climate*, as a contribution to our knowledge of the climate of the kingdom, and thereby of that of Europe and the world at large.

'III. *General Weather Study*, though for this last the observations would be more useful if they were telegraphed daily to a central station, such as my office in London, where they could be compared with other observations made at the same time elsewhere. This is only a question of money, and the sole reason why Rugby is not one of our telegraphic stations is that we do not want, nor if we did could we pay for, more stations than we have in central England.

'The two last-named inquiries, climate and general weather, are carried on in the Meteorological office, and before I speak of them I must say a few words as to the *Local Weather Study*, as that is an inquiry which any one can carry on for himself. There are an abundance of rules for this given in every text-book, and though the results attainable fall far short of the knowledge of weather to be gained from telegraphic reports, it often happens that one is out of the way of the daily weather reports, and even of telegraphy (for storm warnings), and has nothing to trust to but one's own observations and one's dead knowledge. I suppose always that one has a barometer and a pair of thermometers, dry and wet bulb, at least. The first thing to do is to observe regularly; the next is to put down the observations on a ruled form, so as to see how the lines or curves run, as it is quite impossible to trace at a glance all the little changes shown by the readings if you have to look down a column of figures.

'If then you study carefully the course of these lines, marking whether or not they are rising or falling, and whether the change is going on slowly or quickly, a great deal of knowledge may be gained.

'It is always most important to observe the wind carefully and to watch any change in its direction, and also whether or not the clouds are moving in the same direction as the wind at the earth's surface is blowing. The appearance and form of the clouds are also very valuable as signs of what is going on in the atmosphere. By such means as these we shall gain a very fair knowledge of weather, but it would take more than all the time we have for this Paper to give you a full explanation of this part of the subject.

'I must now proceed to tell you what we do in the Meteorological Office in London as regards weather study, which forms, after all, but a part of our duties. I find that not one person in every dozen whom I meet has the faintest conception of what we do there, so perhaps you will let me digress for a minute or two to explain it to you.

'We have three branches.

'I. The original object of the office was *Ocean Meteorology*.

This is studied by getting ships' captains to take observations, just like yours here. From their logs we take out, in the first instance, the wind observations, and so by comparison find out which are the best routes (seldom the most direct) for ships from port to port. In the second place, we study the climate of various parts of the sea, and notice how that affects the climate of the land. These observations can also be used for weather inquiry, for, as you will see presently, if we could possibly get news of what is going on at sea off the coast of Ireland and Scotland to-day, our task of telling what the weather will probably be on Monday would be comparatively easy.

'II. The next branch is the study of our *Climate*, and for this we chiefly make out averages for each class of observations for days, months, and years, and compare them with each other, thereby gaining information which enables us to tell why corn will pay as a crop in central England, while it will be better to have green crops or grazing land in the West of Scotland, or in Ireland. All questions as to the healthiness and the suitability of places for invalids must come to this branch.

'III. The third branch is *Weather Telegraphy*, and this is the subject on which I have to speak especially this evening. It is also naturally the part of our work which attracts the most public notice, though not at all the most really important inquiry that we have to pursue. The proceedings in this department are, in principle, simple enough. We receive every morning some 50 reports, taken nearly at the same time, at various places in these islands and on the adjacent coasts of the Continent. These observations are then laid down on a chart so as to enable us to detect any discrepancy between the reports from adjacent stations, and to see over what districts such and such a general type of weather prevails.

'As soon as this chart has been considered, and our ideas as to present and probable weather have been formed, we send off our report to the newspapers, issue, if necessary, warnings to the coasts, and prepare our chart for publication.

'You may now ask what principles of air motion we have to guide us in "forming our ideas," and this I shall try to explain; but it is not an easy matter to do so, owing to the difficulty of finding suitable illustrations of the subject.

'I suppose you all know the points of resemblance and of contrast between a *liquid* and a *gas*. In both cases the particles have much greater freedom of motion than in a solid, but while a liquid can be kept in an open vessel, in which its surface will remain level, a gas must be enclosed in a complete envelope, else it will quickly flow out and get mixed with the surrounding air. Both states of matter, however, agree in this that if there be produced in a mass of either a surplus or a deficiency of molecules, the tendency of the whole mass will be to put an end to this state of things, and a motion will take place amongst the particles, so that after a short time they will all be at rest again.

'You can see all this taking place in a basin of water, if you pour water in or scoop out some that is in; and what takes place in a mass of gas is very similar, but what corresponds to scooping water out of a basin is a *reduction of pressure*, while what corresponds to the addition of water is an *increase of pressure*. These are indicated, as regards the air, the first by a fall, the second by a rise of the barometer.

'You know that the barometer measures the weight of the air, or, so to speak, the quantity of air over our heads at any time, and so shows whether there be more or less than the proper amount. Whenever there is a change in the pressure, however produced, at any spot, the air all about that spot is set in motion to restore equilibrium, and so WIND is produced.

'It is the direction and force of the wind which are the causes of all our different kinds of weather. We all of us know that S. W. winds present a strong contrast to N. E. ones, the former being warm and moist, the latter cold and dry. It is a remark as old as Aristotle (in the Politics) that as there are only two constitutions, free and despotic, so there are only two great winds, north and south, and all the others are merely secondary currents of air.

'I have told you that the air is set in motion, and wind produced, to restore equilibrium, but I have not explained the principles according to which that motion takes place and the wind blows.

'These principles are quite definite and easily remembered. The wind does not simply rush in from all sides to fill up the vacuum, but moves according to laws, and blows in great curls or sweeps. If the wind is produced by an area of low pressure the circulation will be what is termed cyclonic, or *against* the hands of a watch; if by an area of high pressure it will be anti-cyclonic, or *with* watch hands. I speak in both cases of the northern hemisphere.

'Let us now return to my illustration taken from water motion. The atmosphere over our heads is never really at rest, but is constantly moving on more or less like a gigantic river. If such a river be flowing rapidly you may often see waves and hollows on its surface causing eddies and cross motions. We may suppose that the surface of our atmospheric currents, if we could only see it, would present an appearance somewhat similar, but the waves and hollows would be represented by patches of excessive or defective barometrical pressure, each with its own proper eddies and wind circulations; and these are acting one on another and causing various disturbances; one eddy dying out, another increasing; here two merging into one another, there a large one breaking up into little ones.

'It is a problem of the greatest difficulty to account for the origin of these circulations; we must only admit the fact of their existence, and explain their properties and behaviour as best we can. They vary in size from the local whirlwinds, only a few yards in diameter, like that near Banbury on the 30th of November, 1872, which sweep across half a county, leaving their track an utter wreck, and the gigantic wind systems, like that of January 19, 1873, of which the W. gales of the southern side were felt in Spain, while E. winds were reported from Iceland. In fact, the entire wind circulation of the globe is related to barometrical pressure, and takes place in great eddying gushes of air, round definite areas of high and low pressure. Such an area of high pressure, causing an anticyclone, is found near Madeira, while the neighbourhood of

Iceland is a constant centre of low pressure, with its cyclonic circulation round it.

'This statement, that all the wind is related to barometrical pressure, contains a great principle, and is, in fact, the most important discovery as to weather which has been made for a long time.

'In former days it was said that when the barometer was high the wind would be E., and when it was low the wind would be W. This idea is quite antiquated; we know that the wind always blows according to a fixed rule—Buys Ballot's Law, after the Dutch professor of that name, who first saw its importance. It is as follows:—"Stand with your back to the wind and the barometer will be lower on your left hand than on your right."

'It is easy to test this principle by any of the charts of storms on the wall. The lines, called *Isobars*, join the places where the barometer readings are the same, and they run nearly parallel to each other round the central area, while the wind arrows lie reasonably nearly parallel to these lines. The force of the wind is greater the nearer the lines approach each other, or the greater is the difference in reading between stations close together.

'We know then, from this law, that whenever we have a W. wind the barometer must be lower to the north of us than it is here, and conversely we know that if the barometer be lower, or if it be getting lower in Scotland than here, we must have a W. wind, and a stronger one the greater the difference between the two readings.

'Here you have the first glimpse of the principles on which we judge of wind, and consequently of weather—viz., by the barometer, or as it is vulgarly, but not inaptly termed, the weather glass.

'Let us now see what other aids we have.

'I have already reminded you that the air of the S. W. wind presents a strong contrast to that of the N. E., and if I were to lay down on a chart the conditions of temperature and of cloud and rain for any one of the storms, you would see that on the eastern and southern sides, where we have the S. and

S. W. winds, the air will be warm with mist and rain, while on the western and northern sides, where we have the N. and N. E. winds, the air will be cold and dry.

'In fact, one of the most usual occurrences towards the end of a S. W. gale is that a heavy shower of rain falls, the wind suddenly shifts to N. W., bringing on a clear blue sky.

'Thus you see that over and above the indications of a coming change of weather given by the barometer, we can get most valuable corroborative evidence from the temperature, and the dampness, or the contrary, of the air.

'In addition, there are other most important signs, in the form and character of the clouds, the appearance of the sun and moon, the clearness or haziness of the air, and, if you are near the open sea, the height of the waves and the direction from which they are coming; and, above all, the motion of the upper clouds, inasmuch as storms usually begin aloft, owing to various causes. All such observations as these come under the head of local signs, as they cannot be observed by instruments, and so require a practised eye to recognise them, as I explained at the beginning of the Paper.

'This is precisely the very weakest point of the whole system of telegraphy, and here is where we fall short of the knowledge of fishermen. Over and over again it has happened to me, on my yearly tour of inspection round the coast, to notice coming changes of weather long before our regular telegraphic observers had recognized the signs, though quite unmistakeable to the eye of every one whose business depended on the weather—be he fisherman, farmer, or even Clerk of the Weather. Our telegraphic reporters do their work as a duty, and only very few of them really take a pride in it, so that we cannot trust them to be always on the look-out till we can pay them higher or interest them more in their work.

'It is now time to speak of our system of collecting our intelligence and issuing the results to the public.

'The stations are represented on the diagram, and their position has been chosen so as to give the best information we can get. You will see that on many parts of the West Coast we have no stations, partly because it is so thinly inhabited that there are hardly any telegraphic stations along it, and partly because it is so mountainous that the wind reported will not have blown true, so that if we trusted it we should often be led astray, for the first signs of a storm are usually very light puffs of southerly wind, which will not be felt at all in valleys which are not open to the south.

'If then at any of our stations we find that the reports show any of the signs of an approaching system of wind which I have described to you (let us take a cyclonic system as example, as by far the most usual and also the most important as regards storms), we must first see from our chart how far the reports confirm each other and how far the influence extends.

'Then comes a very difficult task, that of forming a judgment as to whether or not the system will bring a storm with it. This is decided mainly by the rate at which the barometer is falling and the extent of coast affected.

'We have next to try to discover what the probable shape and size of the system will be, and at what rate and in what direction it is moving. As to the two last points we can rarely make up our minds before the gale has burst upon us.

'The rate of advance of a storm varies from about ten miles an hour to about forty, but as a very general rule we may say that the weather which sets in over Ireland to-day will not come to England till to-morrow.

'As regards the direction of motion, that is generally from the westward, but it also takes place from most other points of the compass, the advance from the eastward being, however, excessively rare in these islands.

'From this circumstance of the usual movement, from W. towards E., of the weather systems, you will see that our West Coasts are the first to feel the brunt of storms, and that if by any possibility we could get news from the Atlantic—say half way across to America—we should gain an enormous advantage. This is unfortunately not to be hoped for, and America, or even Newfoundland, is too far off for us to be able to trust the reports absolutely, as the weather changes its character in crossing the ocean.

'Hence I can assert, without fear of contradiction, that, with the exception of my friend, Professor Mohn, in Norway, I have, in studying the weather in England, the most difficult task of all the chiefs of weather offices in Europe; and, as a proof of this, I may say that I can succeed far better in foretelling the weather for Holland and Germany than for our own coasts. In the year 1872 they had 23 storms in Hamburg, and I warned them of 22. I only wish I could do as much for our own coasts, or that I had observers out at sea.

'This will show you, in a general sort of way, what we know about storms, which is simply that as soon as we learn that a storm has shown itself in any part of the region covered by our telegraphic network, we at once telegraph the news to all whom, in our opinion, it may concern.

'Let us now see what insight we have into the probable character of a disturbance which is approaching, and consequently what we know as to the coasts threatened and the direction of the storm by which they are threatened.

'This is, unfortunately, not very much, for I have told you already that we seldom know much about the size of a storm before it has begun; but there are some general principles of great value, which are mostly deductions from Buys Ballot's Law.

'I have already stated what that law is; let us now apply it to the general distribution of pressure. Whenever the barometer is higher in France than it is in England, and in England than in Scotland, there will be a general W. wind. If now a cyclonic system moves across central England, the wind on the southern side of the centre will be westerly, and for a given depth of the barometric depression must blow harder the higher the barometer is in France. On the northern side there ought to be east winds, but, for them to blow hard, the barometer must be much higher in the North of Scotland than at the centre of the storm. But as it very often happens that the lowest reading in England is actually higher than the reading in the North of Scotland (owing to the influence of the Icelandic area of low pressure, of which I spoke some time ago), it is seldom that we can get up the conditions for an easterly gale.

'So when the barometer is highest in Denmark and Norway, and a cyclonic storm comes on, it will blow hardest from the S. and S. E., and the gale will be much worse on our East Coast than on the West.

'As to the north gales we can seldom tell much about them beforehand on our West Coasts, as they come at the tail of a storm, and the high pressure which causes them lies out to seaward; but we know that whenever the barometer is very high over Ireland there is great danger of northerly gales on the East Coast of England.

'It is then to the distribution of pressure that we are to look for the probable character of our storms, and we are gradually coming to the conclusion that to the same relations of pressure we are to look for the probable direction of motion of the storms. If we knew this we should, indeed, have made a grand step in advance.

'It is always to the general distribution of pressure that we are to look for the ordinary indications of a change in the general type of our weather.

'Let us take the coming winter, when most of us wish for some skating. What are we to look for in the daily weather reports as the signs of a coming frost?

'In the first place, we must see whether or not the barometer in France and the South continues high: if it does, we need never trust an odd cold day to be the commencement of a frost.

'Let the readings in France fall well below those in the North of Scotland—not too much so, for that will cause too strong a wind, and will probably be only the precursor of an opposite change; and let us see the frost well established over the Baltic and Norway, with light airs of wind in these islands, and with a good deal of fog on our South-west Coasts; we shall have a fair chance of a week or two of hard black frost.

'If this has once set in, the first signs of its breaking up will be quite unmistakeable; there will be "cirrus" clouds and coloured rings round the moon, with perhaps a lunar halo. If this appears for one or two nights in succession you may be sure that the frost will be checked, perhaps utterly broken, and that there will be a chance of hunting.

'It is not possible to go further into the subject in the course of such a Paper as this, but I hope I have said enough to show you that we have some definite principles to guide us, although these are far from perfect as yet. That we can get some good out of them is shown, on the principle that "the proof of the pudding is in the eating," by the fact that we were generally right in giving news of and foreseeing 80 out of 100 cases of storms last year.'

MEETING HELD DEC. 6:—*Exhibition:* Local and Holiday Prize Collections of Lepidoptera, by A. J. Solly.

The following Paper was read by Mr. W. C. Marshall (corresponding member) on '*Mode of Escape of Sesia apiformis from its Cocoon*':—

'The subject of the short Paper I am sending to the Society is the way in which certain moths escape from their cocoons; but perhaps it would be more proper to call it a note on the habits of Sesia apiformis, as my remarks are almost entirely suggested by that insect.

'The way in which many moths escape from their cocoons has long been a puzzle. Of course a stout covering is of great advantage in protecting the helpless chrysalis from its numerous enemies—birds, mice, centipedes, earwigs, woodlice, &c.—and one is not surprised to find the protection common; but I think it is surprising that the means of escape which one would expect to accompany this protection are not more obvious than they are.

'I believe these moths have two ways of getting out.

'First, by excreting some solvent of the glue of which the cocoons of many are, to a large extent, made. I have seen this suggested, but have never seen any positive evidence on the point. Wherever this is the means of escape I think the moth breaks through the chrysalis before it breaks through the cocoon, and the chrysalis will be found in the cocoon after the moth has come out. I believe the Puss Moth (Dicranura vinula) and the December Moth (Pœcilocampa Populi) are good instances.

'The second way of escape is mechanical, by rubbing or scraping a hole in the cocoon, through which the insect emerges. In this case the chrysalis comes out of the cocoon before the insect comes out of the chrysalis, and the empty chrysalis will be found either entirely free from the cocoon, or more frequently half out. It is an instance of this that I wish particularly to describe.

'The caterpillar of Sesia apiformis (the Hornet Moth) feeds in the roots of poplars, and when it is full grown it eats its way to the surface of the tree; if it is above the level of the ground, it stops when there is a very thin layer of bark over it; if below the level of the ground, it works its way right out into the soil. In either case it spins a tough cocoon made of small pieces of wood glued together, and the whole bound up and lined with silk. This takes place about the beginning of November, the caterpillar hybernates and changes to a chrysalis in March, and the moth comes out in May. I kept a number of the cocoons at Cambridge. The first sign of life I perceived in the spring was a distinct scraping noise, and this went on for two or three days before any moths came out. I took a cocoon out and cut a hole in the side. When he recovered from the disturbance the chrysalis began turning round in the cocoon, first in one direction and then in the other; and from the way in which he occasionally slipped seemed to be exerting a good deal of force.

'When the cocoon eventually breaks it does so in a remarkable way: a small round cap comes off the top, much in the way in which the capsule of a Pimpernel opens, and sometimes nearly as neat. The chrysalis then comes out of the cocoon, either partially or entirely, then splits down the back and discloses the insect.

'Now, if you will look at the drawing of the insect (Plate ii.) you will see that the chrysalis is a peculiar one. The covering of the abdomen is very extensible, and each segment has on the *back* one or two rows of spines or teeth pointing downwards. Also, there are three points on the front of the head, the principal one (A), where the antennæ meet, is chisel-shaped and very hard, the other two (B) stand over the base of the palpi.

'It is evident that by expanding and contracting the segments with a wriggling motion the insect can easily turn round, and at the same time keep its head pressed against the top of the cocoon.

'This expansion seems to take place in a rhythmical way, so that one segment after another comes in contact with the side of the cocoon in regular order. You will also see that the position of the spines on the *back* of the abdomen will cause the *front* of the head, on which are the three points, to be pressed against the side. The conclusion is irresistible that these points cut the top off the cocoon, or, at any rate, so weaken the line they rub as to determine the point of fracture. And if this is the case, I think it forms a remarkable instance of correlation of form and habit to attain an end of undoubted advantage to the insect, and is a fact especially interesting from the natural selection point of view. I think similar habits are to be expected in the Sesiadæ, Zeuzeridæ and Hepialidæ, which have, as far as I have seen, chrysalises of similar form. The common Burnet Moth, Zygæna Filipendulæ, which is abundant about Rugby, I fancy breaks through its chrysalis in a similar way. I kept a number when I was at Rugby, and observed them jumping about in a very ridiculous way before they came out. The chrysalis has a ridge down the back, if I remember right, and the cocoon splits frequently in a line corresponding to this; but I cannot speak with any certainty. This might easily be settled by any member of the Society who will take the trouble to gather a dozen or two of the cocoons.'

Dr. Oldham, Director of the Geological Survey of India, then read the following Paper on the '*Coal Fields of British India*':—

'There would seem to be much want of any general information regarding the extent, or even the existence of Coal in British India, and a few words on the subject may be interesting to the Society.

'Briefly alluding to the immense area of British India, he sketched out its main physical features, shewed that the peninsula was markedly separated from the Himalayan area on the north and from the hill country to the west of the Indus by an immense plain, or series of plains, the highest point of which scarcely exceeded 400 feet above level of sea. The peninsula had, in fact, been formerly a great island. The direction and character of the hill ranges in the peninsula proper were then noticed, and the very peculiar distribution of the drainage of the country, depending on this arrangement of the hilly ranges, indicated.

'In geological structure India presented a good deal of simplicity, due to the very large areas covered by the same formations, combined with a large amount of complexity and difficulty—depending, in part, on the isolated and limited areas over which some of the rocks occur, and the comparative absence of organic remains by which the succession could be established.

'At the base of all, and covering an immense area in the south and centre of the peninsula, and also in the Himalaya, comes highly metamorphic gneiss, so crystalline in many places as to become a true granite, and throughout of granitoid type. This is found traversed by numerous reefs or veins of quartz, of pegmatite, of felspar (orthoclase), and, in most places, by a most wonderful series of trap dykes—almost too numerous to count, and though rarely exceeding a few feet in width, often preserving for fifty miles and more a perfectly rectilinear direction, with but very slight variation in size or mineral character.

'Next in succession come a series of schistose and quartzitic rocks, much cleaved and greatly contorted, to which, in the South of India, the name of *Kuddapa* rocks has been given, from their extensive occurrence in the Kuddapa districts. In a similar way the name of the adjoining district of *Kurnool* has been given to the group of rocks immediately succeeding, in that part of the country, the Kuddapas. There is between the two, however, a marked and great unconformity, indicating a considerable lapse of time. In other parts of the country, further north, similar rocks have been met with, and, in the absence of any positive proofs of identity, local names have been given by the officers of the Geological Survey of India (*Gwalior*, *Sub-Kymore*, *Bijawur*, &c.): while, at the same time, as the upper portion of these formations appeared at first to have connection with the lower portion of the next succeeding great group in ascending order, to which the name of *Vindhyan* had been given, as being best seen in the great Vindhyan range of hills, these older groups had often been spoken of as Lower Vindhyan. The Vindhyan series, which has just been mentioned, largely consists of sandstones, the prevailing colours of which are red and grey. But there are also intercalated limestones and clays of varying character, which enable the entire series to be easily subdivided into three groups in descending order (*Bundair*, *Rewah*, and *Kymore*). These rocks cover a very large area—nearly 100,000 square miles—and are of great thickness. As yet, no fossils sufficiently distinct to determine the geological age of these rocks have been found. But, judging from analogy in other respects, they are probably of the age, or nearly of the age, of the old red sandstone of Europe. There is every probability also that the entire series in India is of freshwater, or rather estuarine formation, while the varying thickness and varying mineral character of the beds enable us to indicate the probable direction of the waters carrying down these deposits, and the possible limits of these depositing forces.

‘To this great Vindhyan series, with the intervention of a great break and unconformity, succeeds a very thick and widely-deposited series of sandstones and shales, apparently forming one continuous group with local unconformities, characterized by one common fact—namely, that the remains of terrestrial plants occur throughout wherever the conditions for their preservation were favourable. To this entire series, therefore, embracing several very distinct groups, but all characterized by this fact of freshwater and terrestrial formation, a general name of the “plant-bearing series” had been given, as a convenient distinction.

'The lowermost group of this assemblage of formations consists of widely-spread rocks of peculiar type, singularly constant as regards this type, and even its minor characteristics. These rocks were first described in connection with the Talcheer field in Orissa, and the name of *Talcheer* was given to the series. Without entering into any great detail, we may note the most remarkable features in these rocks, which is the occurrence of beds made up of fine silt, in which are imbedded large—often many tons in weight—blocks of older rocks of various kinds, carried from far-distant localities, and frequently much worn. This peculiar admixture of fine silty matrix with huge blocks of hard rocks imbedded, led at once to the suggestion that these deposits owed their origin to glacial forces, presenting, as they did, many of the features characteristic of such ice-borne deposits in these countries. There was nevertheless a difficulty in admitting the existence of glacial conditions within the tropics and under the blazing suns of Indian latitudes, and though no other hypothesis appeared capable of meeting the facts, further evidence was anxiously sought for. No scratched blocks had been found, nor had any furrowing or polishing of the underlying masses been traced. And this continued to be the state of the question for some years, until more recently, this additional evidence was found under conditions favourable for its preservation; and blocks of hard syenitic granite, etc., as beautifully polished, scored and furrowed as any derived from the glacial deposits of more northern latitudes, supplied convincing proof of the accuracy of the suggestion first thrown out by Mr. W. Blanford, who was the original describer of these rocks.

'Associated with these "boulder-beds" are fine muds, now thinly laminated shales, much sub-divided and breaking up into small angular fragments, from which the name of "needle shales" was given to them; and also sandstones, equally jointed and breaking into small dice-like pieces, whence the name of "tesselated sandstones." This peculiar group, known to Indian geologists as the Talcheer series, forms throughout the country generally the immediate forerunner of the Indian coal-measures. There is generally, not always, a slight unconformity between the two, but there is also a certain slight amount of transitional passage, evidencing a continuity of conditions of deposit.

'To the formation containing all the productive coal of the Indian Peninsula the Indian Geological Survey has given the name of the *Damûda* series, from the name of the river Damuda, in the valley of which by much the most important of the coal-fields worked in India is situated. This river is an affluent of the Ganges, or rather of that portion of the Ganges which passes Calcutta and is called the Hooghly.

'The Damûda series is probably best seen in its more easterly developments, and no portion of it is so extensively worked, and therefore so accessible, as the coal-field situated near the village of Ranigunj, and which is therefore often called the Ranigunj field (about 120 miles from Calcutta). Here the entire group is readily divisible into three, the middle portion of the series consisting of *ironstone shales*, of considerable thickness, which are coextensive with the field. Below these, forming the *Barákar*, or lower group, are thick massive sandstones, with some shales and thick irregularly developed beds of coal, while above the ironstone shales are also numerous beds of sandstone, for the most part slightly calcareous, and numerous associated seams of coal and coaly shale. This constitutes what has been called the *Ranigunj* group. The whole Damûda series in the Ranigunj field cannot have less than 10,000 feet thickness, of which this upper group is nearly 5,000. The Ranigunj field or basin contains about 600 square miles of coal-bearing country. There are some fifty collieries at work. The seams vary from 4 feet 6 inches to 35 feet, and the field cannot contain less than fourteen thousand millions of tons of coal. Up to the present, this is by far the most productive and most largely worked field in India. In 1868 it produced more than nine-tenths of the entire quantity raised.

'Passing westward the coal-bearing rocks exhibit a steady and continuous change in their character. The very marked central group of the *ironstone shales* dies out, while at the same time the upper group also disappears, or becomes replaced by a series of beds which contain no deposits of coal. The coal becomes concentrated also in a few thick beds of irregular character, confined to the lower portion of the series. This marked change is further not due to the denudation or wearing away of the portions not now represented, but to a difference in the original deposits—a fact of importance when discussing the origin of these fields.

'As seen on the map of India, shewing these coal-fields, they occur, as in most other countries, in isolated basins or local fields. There is very strong evidence that, to a large extent, in India, this isolation or separation is due to original limitation of deposit, and not, as in most cases in this country is supposed to be the case, to separation by denudation and partial removal of the intervening portions. A reference to the geological map will also shew the general distribution of these coal-fields. It will be noticed that they constitute an irregular belt from the vicinity of the shores of the Bay of Bengal on the east to some hundred miles from Bombay and the Arabian Sea on the west. Although every portion of the country has not yet been examined, sufficient has been done to enable us to state with tolerable confidence that throughout the peninsula of India, south of the river Kistna or Krishna, throughout the whole of Western India, embracing the Bombay Presidency, throughout Rajputana, Indore, Gwalior, Guzerat, Sind, in the greater part of the N. W. provinces, and the great Gangetic plains, no coal is known, and it is highly probable none will be found.

'So far, therefore, as area is concerned, the coal-bearing rocks cover only a small portion, relatively, of the surface of the country. Still that area, small as it may be compared with the immense area of British India, is by no means small in reality. The whole is certainly not less than 35,000 square miles, while the entire area of the coal-bearing rocks in Great Britain is not one-half this. Viewed merely in this way, as to area of coal-bearing rocks, there would only be four states which can shew a greater than India, namely, the *United* States of America (500,000 square miles), China (400,000), Australia (240,000), Russia (150,000), India (35,000). There are, however, many other points to be considered in forming an estimate of the value of such deposits, besides the mere question of extent of area.

'Confined as all the coals of India are to one great belt of country, the basins may still be viewed more in detail in immediate connexion with the prominent physical features of the country. And studied in this way it will be found that they at once combine into groups defined by, or belonging to, the great drainage courses of the country. There is thus a group of basins belonging to the Damûda river basin and those of its affluents; a group of fields belonging to the Sone drainage basin; to that of the Mahanuddy; of the Nerbudda; of the Godavery, &c. And, tracing out this farther, we are led to see the existence of very strong evidence,—coupled with the facts already noticed of the original limitation of the basins of deposition and the variation in the mineral characters of the rocks,—proving that the main features of the great drainage basins of the country have been marked out, and have continued, with only minor alterations, since the periods preceding the Damûda formation, or even the Talcheer.

'All the coals of India agree in texture and physical structure; all are laminated, being built up of successive fine layers of highly fossilized vegetable matter and of fine silt or mud, often highly charged with carbonaceous matter, but often also nearly entirely composed of earthy or clayey substances. Thin laminated pieces of mineralized charcoal are abundant. On the whole, they present a less highly mineralized aspect than the majority of English coals. They are all free-burning, yield a poor coke or none, and are of lower heating value than English coals. This is mainly due to the larger quantity of ash contained, which varies from 6 to 20 per cent. This renders the coals less valuable, especially wherever it is necessary to transport them to any great distance, as there is an average amount of 12 or 13 per cent. of useless matter to be carried with the actual fuel. The fixed carbon in these Indian coals also seldom exceeds 60 per cent. Some contain a very distinct admixture of phosphorus. In all there is a varying amount of sulphur, pyrites being in some cases abundant.

'The true Geological age of these coal-fields is a question to which very widely differing answers have been given. In most works, in which any reference to the matter has been made, the Indian coal is stated to be of Oolitic age. In others, again, to be true Carboniferous. The absence of any fossils other than plants has been the great cause of this doubt. Plants are well known to have by no means the same defined and distinctive distribution geologically as molluscan and other animal remains. And, in addition to this, the evidence derived from these plants, imperfect in itself, has been rendered doubly confused and conflicting by misconceptions as to their distribution, or misstatements as to their relations.

'I gave in a few words a sketch of the various formations older than, and preceding, the coal-bearing rocks in India, as their nature and character was needed to account for the mineral character of these coal-rocks, derived largely from their debris. But I must not enter on the question of the more recent series, further than to allude to one which has been confounded with these coal-bearing rocks. This formation, to which I gave the name of *Rajmahal*, from its occurring in the Rajmahal hills, is remarkable for containing an immense number and great variety of the remains of Cycadaceous plants, with some ferns. Several of these Cycadaceous remains are identical with others which were originally described from the rocks in Cutch, another Indian locality. Recent researches in Cutch, where there occurs an abundance of marine molluscous remains, distinctive in their geological characters, both above and below these beds with plants, have enabled us to fix definitely the relative Geological age of this *Rajmahal* group. This is Oolitic, and of the later portion of the upper Oolitic period of Europe. But the true coal-bearing rocks are entirely below these Rajmahal beds, are separated from them by a distinct unconformity, and by the intervention of another thick series, distinguished by plant remains of a totally different character. So far from their being marked by a prevalence of Cycadaceous forms, as frequently stated, I do not know of the occurrence of a single cycad in the coal-rocks of India. There is in abundance and forming indeed the distinctive fossil, a *Glossopteris* (*G. Browniana*), identical in its typical form and in all the varieties with the same fern, which occurs abundantly in the Australian coal, and which is there stated to be intercalated with true marine fossils of undoubted Carboniferous age. But this Glossopteris was hastily and rashly asserted to be a well-known oolitic form, and on this assertion was based the statement that all the Australian coal also was oolitic. I pointed out, more than 10 years since, that no true *Glossopteris* had ever been found save in Australia or India, and that therefore any such assertions as to the Geological age indicated by it in Europe were baseless. With these Glossopteris remains, however, there occurs a large number of fossil plants belonging to a genus first recognized in the sandstones of the Vosges Mountains, *Schizoneura*. And, further, in the group which immediately succeeds the coal-rocks in India, and which has been called the *Panchet* series, occur remains of Dicynodont and of Labyrinthodont character, which, so far as they go, tend to fix the age of these beds. They are apparently Triassic in their relations, and it follows therefore that the underlying coal-rocks cannot be younger than the Permian of Europe, while they are very possibly older. Indeed, I see nothing to alter the opinion announced ten years since, that the coal-bearing rocks of India probably represent in part the time, which in most parts of Europe is indicated by the marked break in succession which occurs at top of the Permian series, with a large portion of the older period also, as represented by the great thickness of the lower beds of this plant-bearing series.

'We have hitherto spoken of what may be called the true coal-rocks. In addition to these, there are in several places—chiefly in the northern portion of the country, in the outer Himalaya, and in the minor ranges skirting these—small deposits, often merely nests, of lignite and lignitic coal, of little value commercially. Towards the East, in Assam and in the Khasi Hills, these lignites assume a greater importance and form thick beds, with tolerable continuity, of finely mineralized coal of much purity, and capital gas-producing quality. Unfortunately they occur in localities comparatively inaccessible, and have not as yet been economized, excepting for purely local objects. The Geological age of all these deposits appears to be nearly the same, namely, at the close of the Cretaceous and commencement of the Eocene.'

The communication was illustrated by a geological map of India, and maps of some of the separate coal-fields.

REPORT OF SECTIONS FOR 1873.

Astronomical Section.

Report on the Temple Observatory, 1873.

The instruments at present attached to this Observatory are:—

The Alvan Clark Equatorial, 8¼-in. dia. and 110-in. focus.
With Reflector, 12¼-in. dia.
Refractor given by Ormerod, 3⅓-in. dia.
Reflector and Spectroscope for Nebulae, 15-in. dia. and 45-in. focus.
Large Spectroscope for Sun work, and ring slit arrangement.
Micrometer, Sextant, Theodolite.
Heliostat, Sprengel air-pump and tubes, Dawes' solar eyepiece, &c.

These instruments are all in good order, and have been used for instruction.

The Observatory itself is in need of some substantial repair or reconstruction.

The chief work has been the measurement of double and multiple stars, 430 of which have been observed during the past year. Many of them are stars which have not been examined for many years, and a systematic re-examination of such stars is being undertaken, with the view of forming as complete a list as possible of binary systems in which motion is recognizable.

Mr. Percy Smith, F. C. Houghton, W. Larden, and L. Maxwell, are most conspicuous amongst those who have assisted Mr. Wilson and Mr. Seabroke in this work.

The orbit of Σ 1938 has been calculated by Mr. Wilson by means of Herschel's and Thiele's methods, which give a period of 200 years. The orbit of this star had been previously calculated by Hind, but the data had proved to be inaccurate, and the star was departing from the position laid down in its ephemeris.

Mr. Wilson has also given a new solution of the problem of finding the real from the apparent orbit of a double star, by a method purely graphical. These results are published in the monthly notices of the Astronomical Society.

In June, photographs of the moon were taken by H. N. and J. R. Hutchinson, with fair results.

The sun has been observed and drawings of the chromosphere made on 86 days by Mr. Seabroke, and a most decided aggregation of prominences on either side of the equatorial regions is perceived in the drawings, and these are just the regions most frequented by spots, shewing a decided connection between the two phenomena. A paper on the results of these observations has been published in the monthly notices.

Experiments have been made by Mr. Seabroke to determine the heat and light radiating powers of gases at low pressures when excited by the electric current, which tend to shew that the elementary gases give more light in proportion to heat than the compounds.

It has also been shewn that a continuous current of electricity can be maintained between a piece of coke and a platinum plate immersed in nitric acid; the quantity of electricity is, however, small. It is probable that the coke becomes oxidized in the place of the zinc, used in other batteries.

A few drawings of the planets have been made during the year, and in part by members of the School.

The following presents have been made to the Observatory:—

Radcliffe observations for 1870 by Trustees of Radcliffe Observatory.
Plates published by Harward Observatory, by Mr. Wilson.

The number of visitors to the Observatory who made use of the instruments was 380.

During the Lent Term a course of Lectures on Astronomy were given by Mr. Wilson and Mr. Seabroke. They were attended by about 50, some of whom were members of the School, and an examination at the end was passed by many with credit. Mr. Lockyer presented prizes to the two first, W. Larden and Miss M. Moberly.

The Telescope and Observatory were formally presented to the Governing Body of Rugby School by Mr. Wilson on April 30th, 1873. The following is an extract from the reply of the Chairman of the Governing Body, the Lord Bishop of Worcester:—

'*May* 23*rd*, 1873.

'MY DEAR MR. WILSON,

'I communicated your letter of April 30th to the Governing Body of Rugby School. . . . The Governing Body accept with pleasure and gratitude your offer of the Temple Telescope for the use of the School; and they desire me to express to you their sense of the value of your gift, and their best thanks for it. They will not fail in forming plans for new buildings to make arrangements for a suitable and permanent site for it. The question of the appointment of a Curator of the Telescope, and of an annual report of the work done in connection with it, will not be lost sight of in framing the regulations of the School. . . .

'Yours faithfully,

(Signed) 'H. WORCESTER.'

A small silver plate is affixed to the stone pedestal on which the Telescope rests, with the following inscription:—

HOC PERSPICILLUM
IN USUM DAWESII AB ALVANO CLARK ELABORATUM
SCHOLÆ RUGBEIENSI
QUO CŒLI MIRACULA EXPLORENT,
SCIENTIAM AUGEANT, EXERCEANT INGENIA,
IN DEI GLORIAM
FREDERICO TEMPLE AUCTORE
D.D.
J. M. WILSON
A.D. MDCCCLXXI.

Meteorological Section.

The meteorological observations have been continued during the year, Mr. Kirk having been good enough to take them during the holidays.

There is, of course, some little difficulty arising from the frequent change of observers amongst the boys, as new observers are apt to make slips now and then. Precautions, however, are taken as far as possible to detect an error at once.

The barometer appears to be the most popular instrument, and as there are generally two or three fresh candidates to undertake it at our usual monthly meetings, it is frequently arranged that one boy reads it for the first half of the month and another for the second. In this way each gets his turn.

There have been eighteen observers from the School during the year, the same number as last year.

Their names are given below.

As before, the readings were reduced for temperature and sea level, and the averages computed by Mr. Wilson, with the assistance of some of the observers.

H. O. Arnold
R. S. Gunnery
F. T. S. Houghton
H. N. Hutchinson
T. F. Johnson
G. L. King
L. Maxwell
J. W. Nicholson
H. F. Newall
R. D. Oldham
P. R. Page Henderson
J. H. Patry
A. J. Solly
C. G. Steel
F. Swanzy
V. L. Tapling
B. R. Wise
E. T. Wise

It is worth while to call attention to the remarkably low readings of the barometers on the 19th and 20th of January, 1873. They are given below, corrected for temperature and sea level.

Jan. 19th,	8.30 A.M.	28·803
	11.0 P.M.	28·384
Jan. 20th,	8.30 A.M.	28·515
	9.0 P.M.	28·377

The morning readings were those of the School barometer, taken by Mr. Kirk. Those in the evening were taken by myself from my own instrument, a standard by Casella. The actual reading at 9 P.M., on the 20th, was 28·020, which, corrected for temperature only (44° F.), becomes 27·981, and agrees closely with the reading of a compensated Aneroid.

Mr. E. J. Lowe stated in the *Times* that his lowest reading (at Nottingham) was at 11.30 P.M. on the 19th, 28·373 (corrected and reduced).

Mr. G. J. Symons gave the lowest readings recorded since January, 1857 (Camden Square, London), as follows:—

1859,	Dec. 26th,	6.0 A.M.	28·629
1866,	Feb. 11th,	4.30 P.M.	28·606
1872,	Jan. 24th,	4.47 A.M.	28·332
1873,	Jan. 20th,	10.0 A.M.	28·447

T. N. HUTCHINSON.

The following certificate has been received from Kew Observatory:—

Sensitive Minimum Thermometer for Grass, No. 17,519,
by Casella, London.

(VERIFIED UNMOUNTED AND IN A VERTICAL POSITION.)

Corrections to be applied to the scale readings, determined by comparison with the standard instruments at the Kew Observatory.

At 32°	— 0·0
42°	— 0·1
52°	— 0·2
62°	— 0·0
72°	— 0·1

Note 1.—When the sign of the correction is +, the quantity is to be *added* to the observed scale reading, and when — to be *subtracted* from it.

Note 2.—As alcohol wets the capillary glass tube and is very volatile, this instrument ought occasionally to be examined in order to ascertain that there is no liquid above the main column. If there should be some condensed in the top of the tube, by slightly heating this it will be driven down so as to join the main column.

SAMUEL JEFFERY, *Superintendent.*

Kew Observatory, March, 1873.

Meteorological Observations.

January.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches		Re-duced	Dry Bulb	Wet Bulb	Max.	Min.	— Inches
1		39,8	39	46	39	,08	18	29,812	35	34	48	33,4	,24
2	29,418	44,8	43	48,2	38,6		19	28,803	39	38	49,2	35	,17
3	29,640	46	44	47	36	,07	20	28,515	30,2	29,6	44	30	,15
4	29,849	41	40	47,8	38	,22	21	28,895	30	29	35,4	25	,10
5	29,733	39,8	38	53,2	39	,08	22	28,783	35,4	35	39	30	,03
6	29,950	48,2	46	48	37		23	29,512	33	31	44,8	31	,02
7	30,090	45	44	50	45		24	29,541	36,8	36	41	32	
8	29,759	46	44	48	43	,05	25	30,030	25	25	40	24	,01
9	29,555	47	46	50,4	43	,08	26	29,908	37	35	40	25	
10	29,630	48,8	47	51	47	,01	27	30,104	32	32	40	31,6	
11	29,789	49	47	53	47	,09	28	30,096	29,8	27,6	40	28	
12	29,874	45	43,8	53	45	,05	29	30,107	31	29	36	28	
13	29,926	46,8	45,8	49,2	38,6	,02	30	30,067	32,8	31	32,8	29	
14	30,106	49,8	48	52	47		31	30,161	33,4	33	33,6	32	
15	30,017	44,6	44,4	53	41								Total
16	30,046	47,6	45	48	43	,05	Average	29,724	39,5				1,52
17	30,021	37	36	49	35								

February.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	30,149	30	30	39,1	30	,10	17	30,679	34,2	32,2	37,5	33,8	
2	29,561	25	24,8	29,2	24,1	,10	18	30,786	27,1	26,2	36	25	
3	29,684	29,8	29,1	30,1	25	,17	19	30,732	30,2	30	32,2	26,8	
4	30,024	33,5	29,1	30,1	25	,14	20	30,614	26	26	35	25,5	
5	30,167	33,5	33,2	34,0	28,5	,14	21	30,386	29	29	43,4	25,5	
6	30,095	32,0	32,2	34,6	32		22	29,883	33,5	33	33,5	28	
7	30,189	33,6	33,2	34,7	31,1		23	29,902	29,8	27,8	42	22	,01
8		33,8	32,0	36,0	32,8	,01	24	29,847	26	25	36	25,0	,16
9	30,288	34,0	33,6	35,3	32,4	,03	25	29,649	31	31	31,2	25	,08
10	30,245	36,1	36,0	39,8	31,6	,04	26	28,875	44	43,5	44,8	30,2	,15
11	30,476	30,4	29,4	43,3	29,2		27	29,349	36,8	36,0	49,5	36	
12	30,132	36,8	34,0	37,5	30,2		28	29,764	29,5	28,0	41	28	,01
13	30,265	33,3	31,2	41,5	30,2								Total
14	30,285	38,5	38,0	43,8	33,8		Average	30,115	32,55				1,14
15	30,445	37,4	36,8	44,9	33,6								
16	30,626	36,8	35,0	45,5	35,5								

March.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	29,372	32,5	32,1	44	28,0	,23	18	29,809	36,5	35,5	41,4	35,5	,00
2	29,552	38,0	36,0	44,0	32,2	,10	19	29,995	36,8	34,5	43.5	35	,00
3	29,810	38,5	38,0	40,8	35,5	,08	20	30,073	36,5	35	43,8	35	,03
4	29,734	46,6	46	48,5	38	,00	21	30,019	36,8	35,4	42	34,5	,20
5	29,806	40,5	40,2	50	37	,06	22	30,011	34,0	33,5	37,2	29	,02
6	30,049	35,5	35,2	49,8	30	,16	23	30,016	39,5	39,2	47,4	32	,04
7	29,249	43,5	42,5	46,0	35,5	,09	24	30,103	38,8	38,4	45,5	37,8	,01
8	29,585	39,0	36,5	47,5	34	,07	25	30,191	48,8	48,5	55,4	37	,00
9	29,619	43,8	41,5	49,2	33,5	,07	26	30,233	34,5	34	55,6	32,5	,00
10	29,392	36,5	35,5	49,5	34	,08	27	30,128	37	36,5	58	33	,00
11	29,164	34,6	34.0	47,8	31	,05	28	29,911	37,5	37,3	59,4	32,5	,00
12	29,360	34,5	32.5	47	31,7	,00	29	30,017	37	37	62	36	,01
13	29,434	32,7	29,4	41	26,5	,27	30	30,009	46	44,5	59,5	36	,04
14	29,502	31,5	31,0	41	28,8	,00	31	29,809	38,5	38,6	61,8	33,5	
15	29,953	34,4	33,8	35,4	30	,05							Total
16	29,883	33,8	32,0	40,8	32	,29	Average	29,793	37,76				1,95
17		36,5	36	40	33,4	,00							

April.

Date	Barom. Re-duced	Temperature				Rain	Date	Barom. Re-duced	Temperature				Rain
		Dry Bulb	Wet Bulb	Max.	Min.	Inches			Dry Bulb	Wet Bulb	Max.	Min.	Inches
1	29,927	46,8	43,8	54,5	37,4		18	29,782	46,2	45	64,2	42	
2	30,247	45	42,3	58,2	34,5		19	30,118	48	43	63,6	36	
3	30,211	46,9	45,5	59	36,5		20	30,211	51	46	62	33	
4	30,176	47	43,8	56,3	39,2	,33	21	30,263	44,8	42,2	65	36	
5	29,829	47,1	43,4	52	44,8		22	30,076	43,8	42	62,2	37	
6	29,655	45	40,3	52,9	38	,16	23	29,985	40	36,8	48	31,6	
7	29,893	40,4	38,2	50,5	36,8		24	29,967	38,8	34	48	29	
8	30,114	41,3	38,2	45,2	36		25	30,175	37	34	48	28,8	,02
9	30,337	42	38	51,6	37,3		26	30,295	38	34,6	46	28,2	,10
10	30,384	39,8	38	47	25,9		27	30,013	42	40	50,2	38	,01
11	30,166	42,7	41	54,8	34		28	30,159	48,8	45	68,8	37,4	
12	30,093	42,2	40	45,2	39,8		29	30,093	51	46,8	54	45	,01
13	30,016						30	30,218	50	47	54,6	39	
14	29,903	49,3	46,0	49,5	36								Total
15	29,729	60,2	53,2	60,2	55		Average	30,042	45,38				,80
16	29,631	55	52,4	73,2	55	,16							
17	29,599	46	45	70	45	,01							

May.

1	30,150	50,2	49	54	49		18	29,701	42,8	42,2	61	42,7	,03
2	30,028	54	48,2	62,8	37,4		19	29,985	42,3	39,4	43,8	38,7	
3	29,704	52,2	46	62,2	41,4	,11	20	30,328	47,4	42,3	53,1	32,2	,44
4	29,777	45	42	56,8	39	,30	21	30,074	46	45,3	59,8	49,3	,11
5	29,463	47,2	46,4	57,2	41	,42	22	29,952	53,8	51,9	54,5	45,1	,04
6	29,509	47,8	43,2	57,8	36,4	,04	23	29,700	53,8	53	64	47	,02
7	29,562	47,6	44	55	37,8	,10	24	30,089	50,4	45,1	65,2	38,2	
8	29,554	49	47	52,2	39	,03	25	30,286	56	50,1	60,8	38,5	
9	29,958	50,5	48,1	55,2	37,3	,09	26	29,994	54,5	49,3	63,1	47,8	,16
10	30,118	50,9	47,5	60,4	39,8	,01	27	29,807	52,1	50,6	60,7	43,5	,14
11	30,126	62,4	56,8	63,2	50,5		28	30,217	50,7	46,3	65,5	45,6	
12	30,208	54,4	51	65,7	44,3		29	30,414	51,8	47,5	62,3	39,8	
13	30,203	51	44,9	68,2	35		30	30,309	49,2	44,1	63,2	34,2	
14	30,267	43,1	39,2	60,2	34		31	30,204	50,1	46,5	63,1	26,5	0.17
15	30,140	46,2	42,9	55,1	34								Total
16	30,027	45,3	42	58,5	33,9		Average	29,987	49,7				2,53
17	29,734	48,8	44	61	37,1	,32							

June.

1	29,972	49,5	49	66	44	,01	18	30,018	57,8	54,9	69	49,4	
2	30,153	51,2	48,6	54,3	42	,03	19	30,073	58,8	55,1	71,2	53,3	
3	29,916	50,2	50	64,8	42	,09	20	30,175	59,6	56,1	62,3	54	
4	29,886			72	45	,62	21	30,238	63,9	61	69,1	55,4	
5	29,851	58,9	58,4	79,2	56	,21	22	30,107	66,1	64	77,9	60	,01
6	30,079	51,5	50,4	61	50		23	30,080	59,5	55,4	74,8	50,1	
7	30,264	51,8	48,1	58	41,8		24	30,032	57,1	54,5	69,7	45,9	
8	30,212	61	57,8	65,8	49,9		25	29,887	55,9	52	64,6	44,3	
9	30,066	59,1	59	65	48,3	,18	26	30,190					,01
10	29,782	52	50,5	54,9	48,5		27	30,117	62,2	59	62,2	54	
11	29,689	53,2	51,2	68,3	50,2	,07	28	30,010	58,6	55,2	70,8	54,2	
12	29,596	54,1	50,9	59	47	,03	29	29,994	65	59,8	65,9	48,7	1,43
13	29,602	57,2	56,8	68,2	48,3	,89	30	29,812	55	54,3	75	55	,01
14	29,765	55,5	58,2	64,6	49	,04							Total
15	29,833	58,9	55	65	49,3	,01	Average	29,979	57,27				3,64
16	29,951	57,2	57,2	67,9	45,7								
17	30,018	62,9	56,6	68,8	49,5								

July.

Date	Barom.	Temperature				Rain	Date	Barom.	Temperature				Rain
	Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Inches		Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Inches
1	30,003	55,2	59,8	68	53,7		18	29,894	59	57,5	68	57	
2	30,026	62,1	57,6	68,8	52	,02	19	30,166	58,5	57	66,2	44	
3	29,901	59,6	57,8	67	57	,23	20	30,129	64,5	61	65,2	53,5	
4	29,713	57,5	53,8	62	51,8	,03	21	30,187	71	67	78,5	56	
5	29,840	53,8	53	65,8	46,2	,11	22	30,048	75,5	69	82,8	61	,02
6	29,854	58	53,8	65,6	53,2		23	29,922	70	68	88,2	65	,01
7	30,100	61,6	56	69	46,2		24	30,044	68,2	56,8	81,5	55,2	
8	30,102	63,6	57,2	73	50,5		25	29,995	65,8	61	70	58,5	,32
9	30,141	59	55	75,5	49		26	29,939	59,5	57	71,2	56,5	
10	29,873	60,6	58	69,2	53,8		27	29,956	59,8	55,8	70,5	52	,11
11	29,850	59,8	55	71,2	51		28	30,006	61,8	58	68	57,8	,21
12	29,759	57,5	54,8	64,6	48	,16	29	29,964	65	60,8	68	42,5	,04
13	29,683	57,5	54,2	69,4	47	,73	30	30,058	66,5	59,5	73	57,8	,07
14	29,667	57,8	55	63,2	46	,03	31	30,058	69,5	62,8	73,2	57,5	
15	29,743	56,5	53	68	49	,09							Total
16	30,045	58	53,8	64,5	49		Average	29,737	61,7				2,27
17	30,072	60,5	58,5	69	52	,09							
August.													
1	30,052	59	56	72	56,4	0,05	18	29,807	56	54	66,2	52,4	
2	30,177	63	57	64,8	57,2		19	29,581	53,4	53	62,4	52	0,40
3	30,126	61	58	70,4	53,6		20	29,764	59	54,6	63,8	49	0,05
4	30,159	54,6	53	71	47,2	0,01	21	29,772	56,8	55,2	59	49,8	0,27
5	29,946	63	59	66,4	54	0,04	22	29,843	61	57	68,6	50,6	
6	29,891	62,6	58,8	73	56,6		23	29,895	60,4	57,2	69,2	48,8	
7	30,088	66,8	63,8	69,2	60		24	29,892	61	60	70	55,8	0,06
8	30,012	65	62	81	55		25	29,883	64,8	62,6	72,8	57	0,19
9	29,892	58	53	79	51	0,02	26	29,853	62	58	76,6	55	
10	30,273	59	52,8	64	48		27	29,884	60,6	57	71	53	0,21
11	29,947	55,4	54,2	65,4	51,8	0,10	28	29,512	59,8	54,2	68,4	54	0,08
12	30,038	63	60	64	53,2	0,03	29	29,658	48,8	47	60	46,4	0,27
13	29,818	64	59	72	59	0,15	30	29,734	57,6	54	61,2	47,8	0,15
14	30,064	62	57	71	53		31	29,848	57	56	67	52,8	0,12
15	30,042	62,8	61	72,8	55,8	0,01							Total
16	29,974	62	60	72,4	59,8		Average	29,925	59,9				2,21
17	30,171	59	53	71	49								
September.													
1	29,730	60,4	59,8	66,2	57	0,15	18	29,854	52	48,8	67,4	46	
2	29,751	55	52	65	51	0,04	19	30,108	49,8	47	62	44,8	0,01
3	29,979	53	51,4	59	45	0,16	20	30,040	60	58	60,4	49	0,01
4	30,067	52,8	52	63,4	46		21	30,243	54	51	65,8	51,4	
5	30,123	51	48	59	46		22	30,551	49	46	59	36,8	
6	30,008	51,2	47	58	43,6	0,05	23	30,466	48,8	46,8	61	39,8	
7	29,783	51	48	56	43,8	0,05	24	30,371	52,4	49,2	65	42	
8	29,799	49	68	57	38	0,03	25	30,287	52	50	68	49	
9	29,757	55	53,2	62,2	43	0,20	26	30,178	54	52	65,2	41	
10	29,610	54,8	51	58,4	50,2	0,11	27	29,991	55,2	52,2	69	43	
11	29,812	54,8	52	64	50		28	29,912	58	56	72,4	48,8	
12	29,856	55,6	52,2	64	46,8		29	30,251	43	41	59	31	
13	29,880	53	50	64,8	41	0,16	30	30,209	49,8	47	61,8	39,8	
14	29,597	54	52	60	46	0,03							Total
15	29,233	52,2	49	61,6	47,2	0,27	Average	29,661	52,9				1,28
16	29,642	51,2	47	60,4	44	0,01							
17	29,666	55,2	54,8	60,2	43,8								

October.

Date	Barom. Re-duced	Temperature				Rain — Inches	Date	Barom. Re-duced	Temperature				Rain — Inches
		Dry Bulb	Wet Bulb	Max.	Min.				Dry Bulb	Wet Bulb	Max.	Min.	
1	29,954	57,5	57,0	59,0	49,0		18	30,019	51,0	50,0	59,0	47,0	
2	30,032	58,0	57,5	66,5	54,5	,03	19	30,175	40,0	39,5	59,0	36,0	,01
3	29,909	60,5	59,5	68,0	57,0	,04	20	29,849	46,0	43,0	60,0	39,0	,01
4	29,972	54,0	53,2	70,0	53,5		21	29,873	42,0	39,5	51,5	35,0	,41
5	30,142	50,0	48,5	55,0	47,5		22	29,200	49,0	48,0	53,0	41,0	,38
6	30,134	50,0	48,5	57,5	45,0	,05	23	29,041	38,0	37,5	58,0	38,0	
7	29,699	49,5	49,0	52,5	47,0	,25	24	29,283	34,5	34,0	42,0	31,0	,05
8	29,760	39,5	39,0	50,0	35,0	,11	25	29,574	35,0	34,0	51,0	33,0	
9	29,891	38,5	38,0	53,0	33,0	,08	26	29,922	38,0	37,0	50,0	30,0	
10	29,670	58,0	56,5	58,0	33,0		27	30,379	34,0	33,0	50,0	31,0	
11	29,702	59,0	57,0	66,0	57,0	,10	28	30,553	29,5	29,0	50,0	23,0	
12	29,793	46,5	46,0	61,0	42,0	,19	29	30,317	29,0	28,0	48,0	24,0	
13	29,650	29,0	38,5	51,0	38,0	,01	30	30,029	33,0	32,0	49,0	28,0	
14	29,884	41,5	40,0	50,0	38,0		31	29,653	41,0	40	49,0	33,0	,22
15	29,986	42,5	41,5	55,0	35,0	,04							
16	30,061	43,0	42,5	52,5	39,0		Average	29,877	44,3			23,0	Total 1,98
17	30,129	48,5	47,0	59,0	42,0								

November.

Date	Barom. Re-duced	Temperature				Rain — Inches	Date	Barom. Re-duced	Temperature				Rain — Inches
		Dry Bulb	Wet Bulb	Max.	Min.				Dry Bulb	Wet Bulb	Max.	Min.	
1	29,123	43,1	41,8	52,4	40,5		18	30,420	39,4	39,1	42,2	38,5	,01
2	29,289	37,2	36,0	51,4	33,5	,14	19	30,163	41,0	40,5	46,2	38,0	
3	29,427	36,9	36,7	45,0	35,0	,01	20	30,173	40,0	39,2	45,5	38,5	
4	29,568	38,5	37,6	51,5	31,0	,02	21	30,044	33,0	32,5	43,5	32,0	,08
5	29,450	45,0	44,6	50,0	37,6	,10	22	29,406	50,8	46,5	52,5	32,0	
6	29,327	45,8	45,0	49,0	41,6	,53	23	29,594	51,8	48,0	56,0	46,0	
7	29,512	43,5	43,0	46,8	43	,20	24	29,879	48,4	41,2	51,8	42,2	
8	29,982	45,0	44,2	47,2	43,0	,03	25	30,167	50,8	48,5	52,0	34,0	
9	30,131	42,5	40,6	45,2	41,0	,14	26	29,878	51,4	51,2	51,4	37,0	,16
10	30,158	43	42,0	46,5	37,5	,15	27	29,413	43,2	41,0	53,5	41,0	
11	30,316	38,1	37,2	43,2	37,0		28	29,929	42,5	40,2	49,3	40,0	
12	30,131	38,8	38,0	47,0	33,2		29	29,783	51,5	49,3	52,5	42,0	,05
13	29,914	26,8	26,4	46,8	25,2		30	29,873	43,2	40,3	53,2	40,2	,01
14	30,014	36,8	31,1	40,0	26,0								
15	30,386	40,4	33,2	43,0	33,0		Average	29,878	42,2			25,2	Total 1,63
16	30,494	38,0	36,5	49,2	30,0								
17	30,510	40,2	39,0	42,5	35,2								

December.

Date	Barom. Re-duced	Temperature				Rain — Inches	Date	Barom. Re-duced	Temperature				Rain — Inches
		Dry Bulb	Wet Bulb	Max.	Min.				Dry Bulb	Wet Bulb	Max.	Min.	
1	30,462	40	39	46,8	34,5		18	30,162	48	46,2	53	45	
2	30,507	46,6	46	48	39		19	30,015	46	45,2	50,6	42,8	0,20
3	30,596	46,5	45,5	55,8	46		20	29,936	36	36	48	35,4	0,01
4	30,623	40	39	47	36		21	30,119	44,8	43	47	36	0,03
5	30,445	41	40	44	39		22	30,000	43,8	43	48	43	
6	30,423						23	30,129	39,8	38	46	36	0,01
7	30,552					0,1	24	30,204	46	44	50	44	
8	30,581	43	41,4	44	38,5		25	30,314	40,4	40	48,2	37	
9	30,588	34,6	31,2	45,2	33,6		26	30,122	41	40	46	40	0,15
10	30,571	24,8	24,8	46,8	24,6		27	29,811	36	36	45	35,8	0,01
11	30,652	21,2	21,2	41,4	20		28	30,222	25,8	25	41	25	
12	30,692	20	20	41	19		29	30,051	30,8	30	30,8	25,4	
13	30,657	29,8	29,2	32,4	25		30	29,845	2	30,2	39	31	0,06
14	30,499	30,4	30,2	37,2	27		31	29,517	42,4	41,8	46,2	38	
15	30,181	35	34	55	30	0,03							
16	29,791	54	52	54	35	0,01	Average	30,271	38,0				Total 0,61
17	30,139	48,8	48	56	40								

Entomological Section.

There have been a few additions made to the Rugby list during the past year. They are not extensive; partly on account of the bad summer and partly on account of the great scarcity of real working members in this Section. The best species added to our local list this year was Orgyia Gonostigma, taken by A. J. Solly.

Additions to the Local List.

Dicranura bifida
Orgyia Gonostigma
Euperia Fulvago
Noctua plecta
Cidaria ~~d~~ilaceata s/

Only five new species, and those not at all striking, seem to constitute the whole result of the work of this Section for a year.

The absence of Mr. Sidgwick from England prevents our obtaining from him the record of his observations last year.

H. VICARS.

Botanical Section.

A special report of the observations made by this Section will be printed next Term.

Considerable progress has been made with a collection of local plants in a form accessible to all.

The following have assisted the President in this work—

R. A. Fayrer
G. L. King
H. W. Trott
V. H. Veley
E. T. Wise

E. T. WISE.

Zoological Section.

List of Notices.

Rook's nest begun in 'Three Trees'	Feb. 14	
Blackbird's nest, (with eggs)	April 3	R. Cunliffe
Cuckoo heard on Dunchurch Road	May 3	C. M. Chadwick
Missel Thrush's nest, (three eggs)	May 3	F. Sykes
Chiff-Chaff, (one egg)	May 4	H. H. Child
Green Linnet, (hard set)	May 4	R. Cunliffe
Hedge-Sparrow, (with eggs)	May 4	C. M. Chadwick
Thrushes and Blackbirds, (full fledged)	May 6	C. M. Chadwick
Goldfinch, (two eggs)	May 10	R. Cunliffe
Corncrake heard at Newbold	May 11	C. M. Chadwick
Rooks, (on the wing), at Rainsbrook	May 15	H. H. Child
Moorhen, (one egg)	May 15	R. Cunliffe
Sedgewarbler, (with eggs)	May 15	R. Cunliffe
Black-headed Bunting, (with eggs)	May 17	R. Cunliffe
Swifts observed	May 19	W. B. Lowe

Yellowhammer, (eggs)	**May 19**	**C. M. Chadwick**
Starlings, (with half-fledged young)	**May 20**	**C. M. Chadwick**
Chaffinch, (hard set)	**May 24**	**C. M. Chadwick**
Skylark, (hard set)	**May 25**	**H. H. Child**
Kingfisher, (4 young, nearly fledged)	**May 25**	**J. Ravenscroft**
Reedwarbler, (eggs)	**May 29**	**C. M. Chadwick**
Woodpigeon, (hard set)	**June 16**	**R. Cunliffe**

C. M. CHADWICK.

The egg cabinet has now been replaced in the Society's room. It is trusted to the care of every Member of the Society. It is desired to form a complete collection of well authenticated Rugby eggs, as well as a general British collection. Contributions towards either collection will be received by

B. R. WISE.

Geological Section.

The Oolitic Drift at Brownsover, May 24, 1873.

The diagrams (Plate iii.) are intended to represent three sections, at right angles to one another, of the stratified oolitic drift on the southern side of Brownsover Hill. To quote from a Paper of Mr. Wilson's in the Report for 1871, "This deposit is about 300 yds. to your left when you have passed through four gates on the road from Brownsover to St. Thomas' Cross. It is an excavation in a sloping field, and exhibits a section of stratified oolitic drift, sloping at various angles. There are belts of sand in it, and everything indicates a shore deposit." . . . "It appears to me to be a portion of an old sea beach, probably formed under the ice-foot in the glacial age."

Section I. is the most important. It is about 10 or 11 feet high, the upper part of which consists of coarse oolitic gravel drift; and the lower part of fine gravel, sugary sand, with several well and sharply marked belts of pure sand. One of these (B, Fig. I.) was seen suddenly to thin out and terminate, as shown at the right hand side of the diagram; which seems to show that such belts of sand are only local, and extend over limited areas.

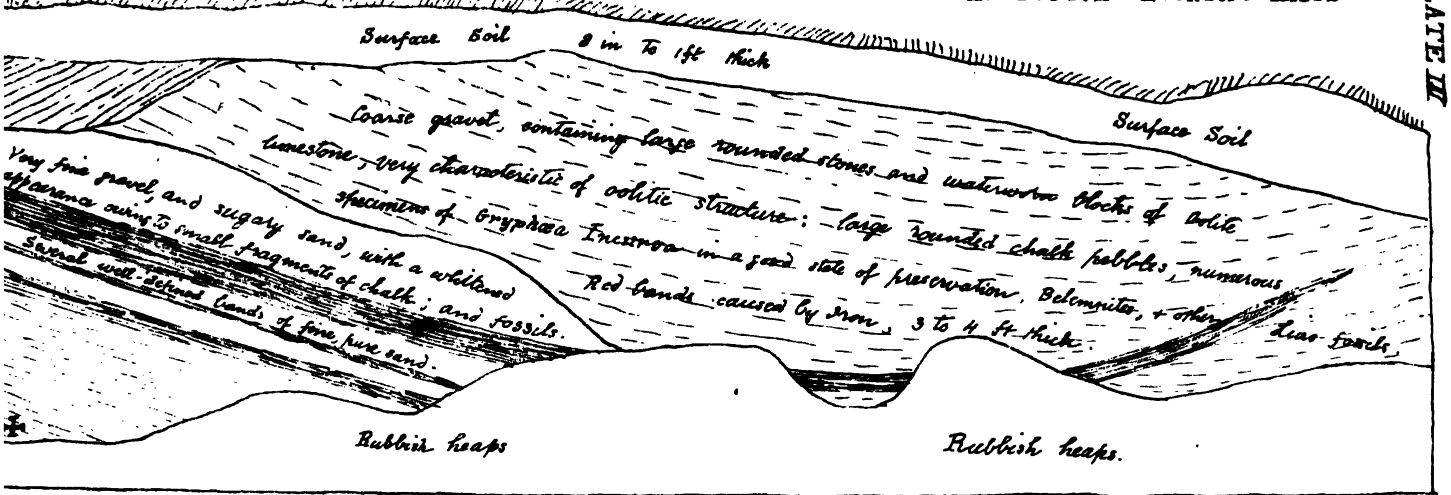
The whole seemed to be stratified rather in the shape of a basin, though conforming to the slope of the hill southwards.

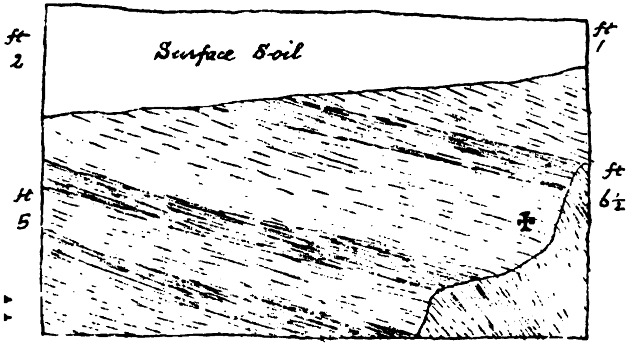
Lias fossils were very numerous, especially "*Gryphoea Incurva*," in good preservation. An entire Ammonite (Communis ?) and numerous fragments, much waterworn, were found; also, portions of other shells, numerous Belemnites, and what looked like red chalk.

The parts in the different sections marked with a cross are different parts of one belt of fine gravel and sand, which, it will be seen, is higher at the west than at the east, and as the faces of sections I. and III. are only about 15 yds. apart, this shows that the drift has a considerable dip to the east; the general dip being about S.E.

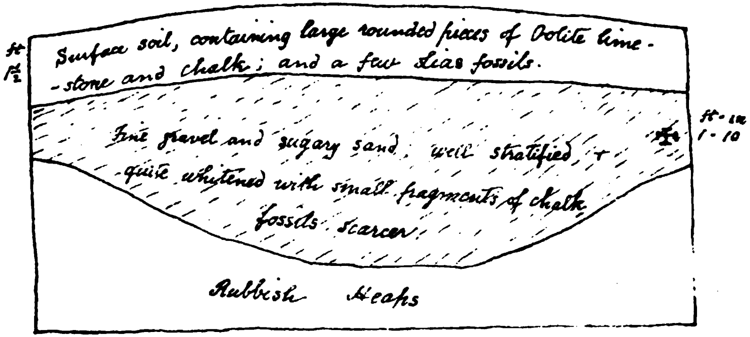
PLATE III

I. SECTION LOOKING EAST


Surface Soil 8 in to 1ft thick
Surface Soil
Coarse gravel, containing large rounded stones and waterworn blocks of Oolite limestone, very characteristic of oolitic structure: large rounded chalk pebbles, numerous specimens of Gryphæa Incurva in a good state of preservation. Belemnites, + other Lias fossils,
Red bands caused by iron, 3 to 4 ft thick.
Very fine gravel, and sugary sand, with a whitened appearance owing to small fragments of chalk; and fossils.
Several well-defined bands of fine pure sand.
Rubbish heaps
Rubbish heaps.



II. SECTION LOOKING NORTH


ft 1½
Surface soil, containing large rounded pieces of Oolite lime-stone and chalk; and a few Lias fossils.
ft 1·10
Fine gravel and sugary sand, well stratified, + quite whitened with small fragments of chalk fossils scarce.
Rubbish Heaps

III. SECTION LOOKING WEST

The measurements may be relied upon.

The three dark bands in Fig. II. are belts of coarse gravel reddened by the presence of iron, and containing concretionary lumps and flat pieces of iron-stone.

Section of the Drift on the slope of the hill to the north of the Bilton Road, just above the Bilton Clay-pit, May 31, 1873.

Surface soil, ½ foot.

Mottled clay, containing striated chalk pebbles, sandstone pebbles, oolitic pebbles (?), and rounded quartzose pebbles, 1 foot 8 inches.

Yellowish brown sand, imperfectly stratified, 7 inches.

Reddish sand, without any pebbles, 4 feet 9 inches.

Layer of brownish-red clay, with small pebbles, about 1 inch.

Yellowish-red sugary sand, to unknown depth.

Section at the Clay-pit, Bilton Road, May 31, 1873.

Red sand, with pebbles of sandstone and quartzite, 3 feet 6 inches.

Light-blue clay, with a layer of limestone about 4 feet from its surface, and several thin bands of yellow concretionary nodules, 10 feet.

Dark blue clay, with a very irregular surface, to unknown depth.

The Drift as exposed at the Victoria Works, New Bilton, May 31, 1873.

Coarse, earthy, brown sand; containing rounded and angular pebbles of quartzite, coarse sandstone and fine sandstone, pure flint, white quartz, and a light, hardish white stone, full of small cavities and brown specks, but apparently no chalk: some of the rounded stones of considerable size.

Estimated percentage of stones and pebbles, by inspection, 15 to 20 per cent.

Section of the Drift at the New Bilton Clay-pits, June 5, 1873.

The total thickness of the drift seems to be nearly 10 feet. It contains some very large blocks of sandstone, rounded, some as large as a man's head. A band through it consists almost entirely of pebbles and stones of quartzite, sandstone, and slate: but in some parts gradually merged into the surrounding sand and gravel. The gravel here seems to be very like, or identical with, that which is exposed at a small cutting made in the roadside on the Lawford Road, about half-way to New Bilton. The drift there exposed is a coarse, earthy, brown sand, containing a large proportion of gravel and pebbles of quartz, quartzite, sandstone, and flint: it has quite a whitened appearance, with small pebbles, and fragments of white quartz. It seemed to be imperfectly stratified, with thin bands of fine sand.

The estimated percentage of stones and pebbles is 30 to 40 per cent.

L. MAXWELL.

LIST OF BOOKS, PAPERS, MAPS, &c., ON THE GEOLOGY, MINERALOGY, AND PALAEONTOLOGY OF WARWICKSHIRE.

By William Whitaker, B.A., (Lond.), of the Geological Survey of England.
Communicated by Mr. Wilson.

Index of Authors, with the Numbers of their Papers, &c.

Agassiz, Prof. L., 98
Allen, B., 2
Anon., 43, 65, 69, 70, 95, 104, 111, 119, 129
Armitage, J., 127

Bauerman, H., 75
Brady, H. B., 90
Brodie, Rev. P. B., 45, 59, 66, 67, 71, 78, 79, 83, 84, 91, 94, 96—100, 103, 105, 106, 112, 120
Bruce, A. C., 113
Buckland, Rev. Prof. W., 9, 11, 32—34
Buckman, Prof. J., 45, 49

Cleminshaw, E., 104, 107, 111, 114
Conybeare, Rev. W. D., 24
Cumberland, G., 14

Dalton, S., 6
Daubeny, Prof. C., 20, 25
Dawes, J. S., 44, 46
Derham, S., 1
Duncan, Prof. P. M., 108

Egerton, Sir P. De M. G., 71
Evershed, H., 60

Farey, J., 5

Gages, A., 80
Gooch, T. L., 29
Greaves, J., 23
Grimes, R., 12

Hedley, — 92
Howell, H. H., 52—58, 61—64, 68, 72—74, 76, 77
Hull, E., 81
Huxley, Prof. T. H., 115, 121

Ick, — 39

Jones, Prof. F. R., 59, 88
Jukes, F., 15, 16, 22

Lambe, W., 4
Lloyd, Dr. G., 35, 50
Lloyd, T. G. B., 122

Moore, C., 85
Murchison, Sir R. I., 26, 36
Musgrave, R. M., 123

Owen, Prof. R., 40, 41

Parkes, S., 10
Percy, Dr. J., 93
Phillips, R., 17, 18
Polwhele, T. R., 75

Ramsay, Prof. A. C., 57, 58, 64

Scudamore, Dr. C., 8
Sedgwick, Rev. Prof. A., 38
Sharpe, D., 21
Short, Dr. T., 3
Smith, T., 30
Smith, T. Mc. D., 116
Smith, W. D., 31
Sowerby, J. D. C., 16
Startin, A., 101
Strickland, H. E., 36, 37, 42, 47, 48
Symonds, Rev. W. S., 86

Thomson, Dr. T., 7
Turner, Prof. E., 19

Ward, Dr. O., 27

Whittem, J. S., 102
Wilson, J. M., 104, 109, 111, 114, 117, 118, 124, 125, 130—132
Wood, S. V. Junr., 126
Woodward, H., 110
Wright, Dr. T., 82, 87, 89
Yates, Rev. J., 13

The following list contains the titles of Papers, &c., by 63 different authors chronologically arranged, from old descriptions of mineral waters down to the more strictly Geological notes of 1873.

List of Works.

1685.

1. **DERHAM, S.** Hydrologia philosophica; or an Account of Ilmington Waters in Warwickshire. 8*vo. Oxon.*

1699.

2. **ALLEN, B.** - The Natural History of the Chalybeat and Purging Waters of England........ 8*vo. Lond.*

1740.

3. **SHORT, DR. T.** An Essay Towards a Natural, Experimental, and Medicinal History of the Principal Mineral Waters of........Warwickshire, &c....... 4*to. Sheffield.*

1798.

4. **LAMBE, W.** - An Analysis of the Waters of two Mineral Springs at Lemington Priors, near Warwick; including Experiments tending to elucidate the Origin of the Muriatic Acid. *Phil. Mag., vol.* i. *pp.* 255, 350.

1811.

5. **FAREY, J.** - A List of about 700 Hills and Eminences in and near to Derbyshire, with the Stratum which occupies the top of each, and other Particulars. *Phil. Mag., vol.* xxxvii. *pp.* 161, 443.

1812.

6. **DALTON, S.** - (Extraordinary Bones found at Rugby.) *Monthly Mag., vol.* xxxiv. *No.* 234, *p.* 407.

1816.

7. **THOMPSON, DR. T.** Geological Sketch of the Country round Birmingham. *Ann. of Phil., vol.* viii. *p.* 161.

1820.

8. **SCUDAMORE, DR. C.** A Chemical and Medical Report of the Properties of the Mineral Waters of........Leamington, &c. .... 8*vo. Lond.*

1821.

9. **BUCKLAND, REV.[DR.]W.** Description of the Quartz Rock of the Lickey Hill in Worcestershire, and of the Strata immediately surrounding it; with considerations on the evidences of a Recent Deluge afforded by the gravel beds of

Warwickshire and Oxfordshire, &c. *Trans. Geol. Soc., vol.* v. *p.* 506.

1822.

10. Parkes, S. - Notice on the Black Oxide of Manganese of Warwickshire. *Trans. Geol. Soc., ser.* 2, *vol.* i. *p.* 168.

1823.

11. Buckland, Rev. Dr. W. Reliquiæ Diluvianæ; or Observations on the Organic Remains contained in Caves, Fissures, and Diluvial Gravel, and on other Geological Phenomena, attesting the Action of an Universal Deluge. (Warwick, pp. 176, 248.) *4to. Lond.*

1825.

12. Grimes, R. - Observations on the Flints of Warwickshire (Roy. Soc.). *Edin. Journ. of Sci., vol.* iii. *p.* 77.

1827.

13. Yates, Rev. J. Observations on the Structure of the Border Country of Salop and North Wales; and of some detached Groups of Transition Rocks in the Midland Counties. (Warwick, *p.* 258.) *Trans. Geol. Soc., ser.* 2, *vol.* ii. *p.* 237.

1829.

14. Cumberland, G. Some Account of the Order in which the Fossil Saurians were discovered. *Quart. Journ. of Sci., Lit. and Art, p.* 345.

15. Jukes, F. - An Account of a new Species of Trilobite, found in the Barr Limestone in the Neighbourhood of Birmingham; with a Note by J. D. C. Sowerby. *Mag. Nat. Hist., vol.* ii. *p.* 41.

16. ———— Notice of some Fragments of Orthoceras annularis and striata, found in the Barr Limestone in Warwickshire; with a Note by J. D. C. Sowerby. *Ibid, p.* 231.

17. Phillips, R. On a new Compound of Oxygen and Manganese; with Remarks on Dr. Turner's Memoir on the Oxides of that Metal. *Phil. Mag., ser.* 2, *vol.* v. *p.* 209.

18. ———— On the Oxides of Manganese. *Ibid, vol.* vi. *p.* 281.

19. Turner, Prof. E. Remarks on Mr. Phillips' Essay on Manganese. *Ibid, vol.* v. *p.* 254.

1830.

20. Daubeny, Dr. C. Memoir on the occurrence of Iodine and Bromine in certain Mineral Waters of South Britain. (Warwick, *pp.* 234, 235.) *Phil. Trans., vol.* cxx. *p.* 233.

21. Sharpe, D. - Description of a New Species of Ichthyosaurus. *Proc. Geol. Soc., vol.* i. *p.* 221.

1831.

22. Jukes, F. - Observations on the Diluvial Gravel in the Neighbourhood of Birmingham. *Mag. Nat. Hist.*, *vol.* iv. *p.* 372.

1832.

23. Greaves, J. A fossilized Fish and Ichthyosaurus found in a Stone Quarry near Stratford-upon-Avon. *Mag. Nat. Hist.*, *vol.* v. *p.* 549.

1834.

24. Conybeare, Rev. W. D. On the probable future Extension of the Coal-fields at present worked. (Warwick, *p.* 347.) *Phil. Mag.*, *ser.* 3, *vol.* iv. *p.* 346.

1835.

25. Daubeny, Prof. C. On Dr. Ure's Paper, in the Phil. Trans., on the Moira Brine Spring, &c. (Warwick, *p.* 322.) *Phil. Mag.*, *ser.* 3, *vol.* vi. *p.* 321.

26. Murchison, [Sir] R. I. On an outlying basin of Lias on the borders of Salop and Cheshire, with a short account of the lower Lias between Gloucester and Worcester. *Proc. Geol. Soc.*, *vol.* ii. *p.* 114.

27. Ward, Dr. O. Lectures on Geology, in illustration of the Strata in the Neighbourhood of Birmingham. *Analyst*, *vol.* ii. *p.* 240.

1836.

28. Agassiz, Prof. [L.] On Ichthyolites (Tetragonolepis from near Stratford-on-Avon). *Analyst*, *vol.* ii. *p.* 132.

29. Gooch, T. L. Account of a Toad found alive imbedded in a Solid Mass of New Red Sandstone. *Rep. Brit. Assoc. for* 1835, *Trans. of Sections*, *p.* 72.

30. Smith, T. - The Miner's Guide; being a Description and Illustration of a Chart of Sections of the principal Mines of Coal and Ironstone in the Counties of Stafford, Salop, Warwick and Durham. *Lond.*

31. Smith, W. D. Birmingham and its Vicinity (with geological notices). *Lond. and Birmingham.*

1837.

32. Buckland, Rev. Dr. W. On the occurrence of silicified trunks of large trees in the new red sandstone or Poikilitic series, at Allesley, near Coventry. *Proc. Geol. Soc.*, *vol.* ii. *p.* 439.

33. ———— On the occurrence of Keuper Sandstone in the upper region of the New Red Sandstone formation or Poikilitic system in England and Wales. *Ibid*, *p.* 453.

1840.

34. Buckland, Rev. Prof. W. On fossil impressions of rain and ripple marks.... and fossil footsteps of Cheirotherium and other un-

known animals recently discovered on strata of the new red sandstone formation, in the counties of Cheshire, Salop, and Warwick. *Proc. Ashmolean Soc., Oxon, No.* xvi., *p.* 5.

35. LLOYD, DR. G. A General Outline of the Geology of Warwickshire, and a Notice of some new Organic Remains of Saurians and Sauroid Fishes belonging to the New Red Sandstone. *Rep. Brit. Assoc. for* 1839, *Trans. of Sections, p.* 73.

36. MURCHISON, [SIR] R. I. and H. E. STRICKLAND. On the Upper Formations of the New Red Sandstone System in Gloucestershire, Worcestershire, and Warwickshire ...... with some account of the underlying sandstone of Ombersley, Bromsgrove, and Warwick...... *Trans. Geol. Soc., ser.* 2, *vol.* v., *p.* 331.

37. STRICKLAND, H. E. On the occurrence of a Fossil Dragon-fly in the Lias of Warwickshire. *Mag. Nat. Hist., ser.* 2, *vol.* iv., *p.* 301.

1841.

38. SEDGWICK, REV. PROF. A. Supplement to a "Synopsis of the English Series of Stratified Rocks inferior to the Old Red Sandstone," with Additional Remarks on the Relations of the Carboniferous Series and Old Red Sandstone of the British Isles. *Proc. Geol. Soc., vol.* iii., *p.* 545.

1842.

39. ICK, — - On some superficial deposits near Birmingham. *Proc. Geol. Soc., vol.* iii., *p.* 731.

40. OWEN, PROF. R. Report on British Fossil Reptiles. Part 2. (Warwick, pp. 155, 181). *Rep. Brit. Assoc. for* 1841, *p.* 60.

41. ———— On the Teeth of Species of the Genus Labyrinthodon common to the German Keuper formation and the Lower Sandstone of Warwick and Leamington. *Trans. Geol. Soc., ser.* 2, *vol.* vi., *p.* 503.

42. STRICKLAND, H. E. Memoir descriptive of a Series of Coloured Sections of the Cuttings on the Birmingham and Gloucester Railway. *Ibid, p.* 545.

1843.

43. ANON. - - Warwickshire. "Surface and Geology," &c. *Penny Cyclopædia, vol.* xxvii., *p.* 84. *fol. Lond.*

44. DAWES, J. S. On the Occurrence of Vegetable Remains, supposed to be Marine, in the New Red Sandstone. *Rep. Brit. Assoc. for* 1842, *Trans. of Sections, p.* 47.

1846.

45. Brodie, Rev. P. B., and [Prof.] J. Buckman. On the Stonesfield Slate of the Cotteswold Hills. *Proc. Geol. Soc., vol.* iv., *p.* 437, and *Quart. Journ. Geol. Soc., vol.* i., *p.* 220.

46. Dawes, J. S. Remarks upon Sternbergiæ. *Ibid, pp.* 359 *and* 91 *respectively.*

47. Strickland, H. E. On certain Calcareo-corneous Bodies found in the outer chambers of Ammonites. *Ibid, p.* 449, *and Ibid, p.* 230.

1849.

48. Strickland, H. E. On the Geology of the Oxford and Rugby Railway. *Proc. Ashmolean Soc., Oxon, vol.* ii., *No.* 25, *p.* 192.

1850.

49. Buckman, Prof. J. On some Fossil Plants from the Lias. *Quart. Journ. Geol. Soc., vol.* vi., *p.* 413.

50. Lloyd, Dr. G. On a New Species of Labyrinthodon from the New Red Sandstone of Warwickshire. *Rep. Brit. Assoc. for* 1849, *Trans. of Sections, p.* 56.

1852.

51. Sheet 62, S. W. of the *Geological Survey Map.* (S. E. corner.) Revised in 1855.

1854.

52, 53. Howell, H. H. Sheets 54, S. E. and S. W. of the *Geological Survey Map.*

1855.

54,55,56. Howell, H. H. Sheets 54, N. E., 63 N. W. (S. E. corner) and S. W. of the *Geological Survey Map.*

57, 58. Ramsay, Prof. A. C. and H. H. Howell. Sheets 53, N. W., and 63 S. E. of the *Geological Survey Map.*

1856.

59. Brodie, Rev. P. B. On the Upper Keuper Sandstone (included in the New Red Marl) of Warwickshire. With a Note on Estheria minuta by [Prof.] T. R. Jones. *Quart. Journ. Geol. Soc., vol.* xii., *p.* 374.

60. Evershed, H. Farming of Warwickshire (with account of soils, &c.) *Journ. Roy. Agric. Soc., vol.* xvii., *p.* 475.

61,62,63. Howell, H. H. Sheets 44 (N. E. corner) and 53, S. W. of the *Geological Survey Map,* and Sheet 48 of the Horizontal Sections (from Lazy Hill, across the Warwickshire Coalfield to Wysall). *Geological Survey.*

64. Ramsay, Prof. A. C., and H. H. Howell. Sheet 62 S. E. of the *Geological Survey Map.* New Edition in 1868.

1857.

65. ANON. - - Kidderminster Deposits (and Passage Beds). *Edin. New Phil. Journ., ser.* 2, *vol.* v., *p.* 380, *and vol.* vi., *p.* 184.

66. BRODIE, REV. P. B. On some Species of Corals in the Lias of Gloucestershire, Worcestershire, Warwickshire, and Scotland [Brit. Assoc.] *Ibid, vol.* v., *p.* 260.

67. ———— Remarks on the Lias of Barrow in Leicestershire, compared with the lower part of that Formation in Gloucestershire, Worcestershire, and Warwickshire. *Ann. and Mag. Nat. Hist., ser.* 2, *vol.* xx., *p.* 190, and *Proc. Cotteswold Nat. Club, vol.* ii., *p.* 139.

68. HOWELL, H. H. Sheet 21 of the Vertical Sections (Warwickshire Coal Field). *Geological Survey.*

1858.

69. ANON. - - Account of Meetings of the Warwickshire Naturalists' Field Club. *Geologist, vol.* i., *p.* 77, 530.

70. ANON. - - Note on the Warwickshire Coal-field. 22*nd Ann. Rep. Warwick Nat. Hist. and Archaeol. Soc., p.* 6.

71. EGERTON, SIR P. DE M. G. Palichthyologic Notes. No. 10. On Palæoniscus superstes. With a "Note on the occurrence of a New Species of Fish in the Upper Keuper Sandstone in Warwickshire" by the REV. P. BRODIE. *Quart. Journ. Geol. Soc., vol.* xiv., *p.* 164.

72,73,74. HOWELL, H. H. Sheets 49, 50 (part) and 51 (part) of the Horizontal Sections of the *Geological Survey.*

1859.

75. BAUERMAN, H., and T. R. POLWHELE. Sheet 45 N. W. (N. W. corner) of the *Geological Survey Map.*

76. HOWELL, H. H. The Geology of the Warwickshire Coal-field and the Permian Rocks and Trias of the Surrounding District. *Geological Survey Memoir,* 8*vo. Lond.*

77. ———— Sheet 53, N. E. of the Geological Survey Map, (W. edge).

1860.

78. BRODIE, REV. P. B. On the Occurrence of Footsteps of Cheirotherium in the Upper Keuper in Warwickshire. *Quart. Journ. Geol. Soc., vol.* xvi., *p.* 278.

79. ———— On the eruptive forces which prevailed during the Triassic, Carboniferous, and Silurian periods in a portion of Warwickshire, Worcestershire, and Staffordshire, and a short account of the nature and origin of Basalt. *Proc. Warwick Nat. and Archaeol. Field Club, p.* 5.

80. Gages, A. - Report on the Results obtained by the Mechanico-Chemical Examination of Rocks and Minerals. (Warwick, p. 67.) *Rep. Brit. Assoc. for* 1859, *p.* 65.

81. Hull, E. - On the New Sub-divisions of the Triassic Rocks of the Central Counties. *Trans. Manchester Geol. Soc., vol.* ii. (*Part* 3), *p.* 22.

82. Wright, Dr. T. On the Zone of Avicula contorta, and the Lower Lias of the South of England. *Quart. Journ. Geol. Soc., vol.* xvi., *p.* 374.

1861.

83. Brodie, Rev. P. B. On the Stratigraphical Position of certain Species of Corals in the Lias. *Rep. Brit. Assoc. for* 1860, *Trans. of Sections, p.* 73.

84. ———— On the Discovery of an ancient Hammer-head in certain Superficial Deposits near Coventry. *Edin. New Phil. Journ., ser.* 2, *vol.* xiv., *p.* 62.

85. Moore, C. - On the Zones of the Lower Lias and the Avicula contorta Zone. *Quart. Journ. Geol. Soc., vol.* xvii., *p.* 483.

86. Symonds, Rev. W. S. On some Phenomena connected with the Drifts of the Severn, Avon, Wye, and Usk. *Edin. New Phil. Journ., ser.* 2, *vol.* xiv., p. 281, and *Rep. Brit. Assoc. for* 1861, *Trans. of Sections, p.* 133 (1862).

87. Wright, Dr. T. A Monograph on the British Fossil Echinodermata, from the Oolitic Formations. Part Fourth, containing the Echimolampidae, the Stratigraphical Distribution of the Echinodermata, &c., (Warwick, pp. 457—459, 462). *Palæontograph. Soc., 4to. Lond.*

1862.

88. Jones, Prof. T. R. A Monograph of the Fossil Estheriae. (Warwick, pp. 58, &c., 67, &c.) *Palæontograph. Soc., 4to. Lond.*

1863.

89. Wright, Dr. T. A Monograph on the British Fossil Echinodermata from the Oolitic Formations. Vol. 2nd, Part 1st. On the Asteroida. (Warwick, *Sections, pp.* 59—61.) *Palæontograph. Soc., 4to. Lond.*

1864.

90. Brady, H. B. On Involutina Liassica. *Geol. Mag., vol.* i. *p.* 193.

91. Brodie, Rev. P. B. (Remarks) on the (two) Lias Outliers at Knowle and Wooton Warwen, in South Warwickshire, and on the presence of the Lias or Rhætic Bone Bed at Copt Heath, its furthest northern extension hitherto recognized in that County. *Proc. Warwick Nat. and Archaeol. Field Club, p.* 26, and *Quart. Journ. Geol. Soc., vol.* xxi. *p.* 159 (1865).

92. HEDLEY, — On the Long Wall System. *Trans. S. Wales Inst. of Eng.*, *vol.* iii. *p.* 148.

93. PERCY, DR. J. Metallurgy (Vol. 2). Iron and Steel. (Analysis of Warwickshire Ore, p. 217.) 8*vo. Lond.*

1865.

94. BRODIE, REV. P. B. Excursion to Fenny Compton, &c. *Proc. Warwick Nat. and Archaeol. Field Club*, *p.* 6.

1866.

95. ANON. - - Notice of the neighbourhood of Nuneaton. *Geol. Mag.*, *vol.* iii. *p.* 273.

96. BRODIE, REV. P. B. On a Section of Lower Lias at Harbury, near Leamington. *Rep. Brit. Assoc. for* 1865, *Trans. of Sections*, *p.* 48.

97. ———— On two New Species of Corals in the Lias of Warwickshire. *Ibid*, *p.* 49.

98. ———— (Remarks) on the Drift in a part of Warwickshire, and on the evidence of Glacial Action which it affords. *Proc. Warwick Nat. and Archaeol. Field Club*, *p.* 14, and *Quart. Journ. Geol. Soc.*, *vol.* xxiii. *p.* 208 (1867).

99. ———— On the fossiliferous beds in the New Red Sandstone (the upper and lower Keuper) in Warwickshire. *Proc. Warwick Nat. and Archaeol. Field Club*, *p.* 33.

100. ———— On the Geology of Warwick, Leamington, and its neighbourhood. 30*th Ann. Rep. Warwick Nat. Hist. and Archaeol. Soc.*

101. STARTIN, A. On some special deposits of drifts in the Parish of Exhall, near Coventry, and also a few remarks on the drift of the surrounding district generally. *Proc. Warwick Nat. and Archaeol. Field Club*, *p.* 26.

102. WHITTEM, J. S. On the supposed Glacial Drift, in the neighbourhood of Coventry. *Ibid*, *p.* 23.

1867.

103. BRODIE, REV. P. B. On the Correlation of the Lower Lias at Barrow-on-Soar, in Leicestershire, with the same Strata in Warwickshire........&c. (Brit. Assoc.) *Ann. and Mag. Nat. Hist.*, *ser.* 3, *vol.* xix. *p.* 31.

1868.

104. WILSON, J. M. A List of Local Lias Fossils. *Rep. Rugby School Nat. Hist. Soc. for* 1867, *p.* 55.

105. BRODIE, REV. P. B. A Sketch of the Lias generally in England, and of the "Insect and Saurian beds" especially in the lower division in the counties of Warwick, Worcester, and Gloucester, with a particular account of the fossils

which characterize them. *Proc. Warwick Nat. and Archaeol. Field Club, p.* 1, and (with a shorter title) in *Trans. Woolhope Nat. Field Club for* 1866, *p.* 205, and *Trans. Dudley and Midland Geol. and Sci. Soc.*

106. Brodie, Rev. P. B. Note on Hyperodapedon from Coton End, Warwick, in *Address to Warwick Nat. Hist. and Archaeol. Soc.*

107. Cleminshaw, E. On the Natural History of the Rugby Lias. *Rep. Rugby School Nat. Hist. Soc. for* 1867, *p.* 31.

108. Duncan, (Prof.) P. M. A Monograph of the British Fossil Corals. Second Series. Part IV. No. 2. [Liassic.] (Warwick, pp. 46, 52, 56, 68.) *Palæontograph. Soc.*, *4to. Lond.*

109. Wilson, J. M. On the Objects of the Geological Section of the Natural History Society. *Rep. Rugby School Nat. Hist. Soc. for* 1867, *p.* 11.

110. Woodward, H. Contributions to British Fossil Crustacea. *Geol. Mag., vol.* v., *p.* 353.

1869.

111. Anon. - [J. M. Wilson, E. Cleminshaw, &c.] Additions to the List of Local Lias Fossils. *Rep. Rugby School Nat. Hist. Soc. for* 1868, *p.* 43.

112. Brodie, Rev. P. B. The Oldest British Belemnite. *Geol. Mag., vol.* vi. *p.* 239.

113. Bruce, A. C. On the accurate Division of the Local Lias at Rugby into Zones, by their Fossils, more especially by their Ammonites. *Rep. Rugby School Nat. Hist. Sco. for* 1868, *p.* 19.

114. Cleminshaw, E. On the River Gravels of the Upper Avon; with a Note by J. M. Wilson. *Ibid, p.* 27.

115. Huxley, Prof. T. H. On Hyperodapedon. *Quart. Journ. Geol. Soc., vol.* xxv. *p.* 138.

116. Smith, T. McD. Account of the Rugby Well. Report by the Engineer (Metrop. Board of Works) on the Boring Operations at Crossness Pumping Station. Revised to Feb. 8. *8vo. Lond.*

117. Wilson, J. M. On the Victoria [Lime] Works. *Rep. Rugby School Nat. Hist. Soc. for* 1868, *p.* 9.

118. ———— Rugby Waterworks. Remarks to accompany the Section of the Well. *Ibid, p.* 41.

1870.

119. Anon. - (Meetings at Bromsgrove and Lutterworth.) *Proc. Warwick Nat. and Archaeol. Field Club, pp.* 24, 31. [See also 35*th Ann. Rep. Warwick Nat. Hist. and Archaeol. Soc., pp.* 25, 27. (1871.)]

120. Brodie, Rev. P. B. On the Geology of Warwickshire. *34th Ann. Rep. Warwick Nat. and Archaeol. Soc., p.* 10.

121. Huxley, Prof. T. H. On the Classification of the Dinosauria, servations on the Dinosauria of the Trias. *Journ. Geol. Soc., vol.* xxvi. *p.* 32.

122. Lloyd, T. G. B. On the Superficial Deposits of Portions of and Severn Valleys and adjoining Distric *p.* 202.

123. Musgrave, R. M. On the drift Gravel of Lutterworth, Kilwo *Proc. Warwick Nat. and Archaeol. Field Club* 23.

124. Wilson, J.M. On the Surface-deposits in the Neighbourh Rugby. *Quart. Journ. Geol. Soc., vol.* xxvi. *p.*

125. ——— On the Drifts and Gravels and Alluvial S Rugby and its Neighbourhood. *Rep. Rugby Nat. Hist. Soc. for* 1869, *p.* 16.

126. Wood, S. V., Jun. Observations on the Sequence of the Glacial *Geol. Mag., vol.* vii. p. 17.

1871.

127. Armitage, J. Localities [of fossils] new to the List. *Rep. School Nat. Hist. Soc. for* 1870, *p.* 45.

128. - - - Report of the Commissioners appointed to in into the several matters relating to Coal in the U Kingdom. Vol. i. General Report, &c.—Report of Committee D........ the probability of finding Coal under the Permian, &c........ Vol. ii. General Minutes and Proceedings of Committees. Warwickshire, p. 388, &c. *fol. Lond.*

1872.

129. Anon. - Excursion to Warwickshire. *Proc. Geol. Assoc., vol.* ii. *No.* 7, *p.* 284.

130. Wilson, J.M. Note on a Boulder lately discovered in Cosford Valley and a Conglomerate Boulder in Brownsover. *Rep. Rugby School Nat. Hist. Soc. for* 1871, *p.* 19.

131. ——— Note on a newly-discovered Oolitic Drift at Brownsover. *Ibid, p.* 20.

132. ——— Catalogue of Local Fossils in the Museum. *Ibid, p.* 55.

[We are greatly indebted to the compiler of this valuable list for the permission to print it, and shall be much obliged to any correspondents who will supplement and complete it, if there should chance to be any omissions in it.—Ed.]

W. BILLINGTON, PRINTER, RUGBY.

C.

THE

LONDON CATALOGUE OF BRITISH PLANTS.

la

Corolla

ophular
Ovary

biate
bs. Ovary
Stam

rvein
Ovary
with

—8.
4.

ord.

—18?

27 europæus, L.—14.

Eranthis.

28 *hyemalis*, Salisb.

Helleborus.

29 viridis, L.—8.
30 fœtidus, L.—8.

Aquilegia.

31 vulgaris, L.—13.

Delphinium.

Isatis.

59 *tinctoria*, L.

Thlaspi.

60 arvense, L.—17.
61 perfoliatum, L.—2.
62 alpestre, L.—7.
  b. occitanum, Jord.
  c. virens, Jord.

Capsella.

63 Bursa pastoris, DC.—18.

93 *Turri*

Turritis.

94 glabr

Barbarea.

95 vulgar
  b. a
96 stricta,
97 *præcox*,

Nasturtium.

98 officinal

120. **Brodie, Rev. P. B.** On the Geology of Warwickshire. *34th Ann. Rep. Warwick Nat. and Archaeol. Soc.*, p. 10.

121. **Huxley,** [redacted] On the Classification of the Dinosauria, with Observations on the Dinosauria of the Trias. *Quart.*

[illegible]
omissions in it.—Ed.]

W. BILLINGTON, PRINTER, RUGBY.

C.

THE

LONDON CATALOGUE OF BRITISH PLANTS.

viridis, L.—8.
fœtidus, L.—8.

A[illegible]EGIA.
31 vulgaris, L.—13.

DELPHINIUM.
Consolida, L.—1.

60 arvense, L.—17.
61 perfoliatum, L.—2.
62 alpestre, L.—7.
b. occitanum, Jord.
c. virens, Jord.

CAPSELLA.
63 Bursa pastoris, DC.—18.

TURRITIS.
94 glabra, L.—10.

BARBAREA.
95 vulgaris, Br.—15.
b. arcuata, Reic
96 stricta, Andrz.—4.
97 *præcox*, Br.

NASTURTIUM.
98 officinale, Br.—18.

120. **Brodie, Rev.** On the Geology of Warwickshire. *34th Ann. Rep.* B. B. — *Warwick Nat. and Archæol. Soc.* p. 10.

rmission to print it, and shall be much obliged to any correspondents
ho will supplement and complete it, if there should chance to be any
nissions in it.—Ed.]

W. BILLINGTON, PRINTER, RUGBY.

C.

THE

LONDON CATALOGUE OF BRITISH PLANTS.

I. RANUNCULACEÆ.

EMATIS.
1 Vitalba, L.—6 or 7.
ALICTRUM.
2 alpinum, L.—9.
3 minus, L.—17.
b. pubescens, Schreb.
3*flexuosum, Reich.—?.
3*saxatile, DC.—?.
4 flavum, L.—16.
NEMONE.
5 Pulsatilla, L.—5.
6 nemorosa, L.—17.
7 *apennina*, L.
8 *ranunculoides*, L.
DONIS.
9 autumnalis, L.—3.
YOSURUS.
10 minimus, L.—9.
ANUNCULUS.
11 aquatilis, L.—18.
a. heterophyllus, Fr.
b. peltatus, Fr.
c. floribundus, Bab.
d. trichophyllus, Chaix.
e. Drouetii, F. Schultz.
11*Baudotii, Godr.—?
b. confusus, Gr. & Go.
11*circinatus, Sibth.—11.
11*fluitans, Lam.—10.
11*tripartitus, DC.—3.
12 cœnosus, Guss.—12.
13 hederaceus, L.—18.
14 Ficaria, L.—18.
15 Flammula, L.—18.
b. reptans, Lightf.—1.
16 Lingua, L.—15.
17 ophioglossifolius, Vill.—C.
18 auricomus, L.—15.
19 acris, L.—18.
20 repens, L.—18.
21 bulbosus, L.—16.
22 hirsutus. Curt.—16.
23 sceleratus, L.—18.
24 parviflorus, L.—11.
25 arvensis, L.—14.
ALTHA.
26 palustris, L.—18.
b. radicans, Forst.—1.
ROLLIUS.
27 europæus, L.—14.
RANTHIS.
28 *hyemalis*, Salisb.
HELLEBORUS.
29 viridis, L—8.
30 fœtidus, L.—8.
QUILEGIA.
31 vulgaris, L.—13.
ELPHINIUM.
32 Consolida, L.—1.
ACONITUM.
33 Napellus, L —4.
ACTÆA.
34 spicata, L.—1.

I*. BERBERACEÆ.

BERBERIS.
35 vulgaris, L.—14.

II. NYMPHÆACEÆ.

NYMPHÆA.
36 alba, L.—18.
NUPHAR.
37 lutea, Sm.—16.
38 pumila, DC.—2.

III. PAPAVERACEÆ.

PAPAVER.
39 hybridum, L.—9.
40 Argemone, L.—17.
41 dubium, L.—18.
42 Rhœas, L.—15.
43 *somniferum*, L.
43*setigerum, DC.
MECONOPSIS.
44 cambrica, Vig.—5.
CHELIDONIUM.
45 majus, L.—14.
GLAUCIUM.
46 luteum, Scop.—15.
47 *violaceum*, Sm.

III.* FUMARIACEÆ.

CORYDALIS.
48 claviculata, DC.—17.
49 *lutea*, DC.
49*solida, Sm.
FUMARIA.
50 capreolata, L.—18?
51 officinalis, L.—18.
52 micrantha, Lag.—7.
53 parviflora, Lam.—2.
54 Vaillantii, Lois.—4.

IV. CRUCIFERÆ.

CAKILE.
55 maritima, Scop.—18.
CRAMBE.
56 maritima, L.—12.
CORONOPUS.
57 didyma, Sm.—4.
58 Ruellii, Gaert.—15.
ISATIS.
59 *tinctoria*, L.
THLASPI.
60 arvense, L.—17.
61 perfoliatum, L.—2.
62 alpestre, L.—7.
b. occitanum, Jord.
c. virens, Jord.
CAPSELLA.
63 Bursa pastoris, DC.—18.
HUTCHINSIA.
64 petræa, Br.—6.
TEESDALIA.
65 nudicaulis, Br.—15.
IBERIS.
66 amara, L.—2.
LEPIDIUM.
67 latifolium, L.—5.
68 *Draba*, L.
69 Smithii, Hook.—16.
70 campestre, Br.—15.
71 ruderale, L.—5.
COCHLEARIA.
72 officinalis, L.—18.
b. alpina (Bab.)—8.
c. danica, L.—13.
d. anglica, L.—14.
ARMORACIA.
73 *rusticana*, Baumg.
SUBULARIA.
74 aquatica, L.—6.
DRABA.
75 aizoides, L.—1.
76. rupestris, Br. 2.
77 incana, L.—9.
78 muralis, L.—6.
79 verna, L.—17.
b. inflata, Hook.
c. brachycarpa, Jord.
CAMELINA.
80 *sativa*, Crantz.
KONIGA.
81 *maritima*, Br.
ALYSSUM.
82 *calycinum*, L.
DENTARIA.
83 bulbifera, L.—3.
CARDAMINE.
84 amara, L.—15.
85 pratensis, L.—18.
86 hirsuta, L.—18.
b. sylvatica, Link.—18?
87 impatiens, L.—6.
ARABIS.
88 thaliana, L.—17.
89 petræa, Crantz—6.
90 stricta,—Huds. 2.
91 ciliata, Br.—1.
b. hispida.—1
92 hirsuta, Br.—17.
93 *Turrita*, L.
TURRITIS.
94 glabra, L.—10.
BARBAREA.
95 vulgaris, Br.—15.
b. arcuata, Reich.—4.
96 stricta, Andrz.—4.
97 *præcox*, Br.
NASTURTIUM.
98 officinale, Br.—18.

99 terrestre, Br.—16.
100 sylvestre, Br.—13.
101 amphibium, Br.—10.

Sisymbrium.
102 officinale, Scop.—18.
103 Irio, L.—4.
104 Sophia, L.—15.
105 *polyceratium*, L.

Erysimum.
106 cheiranthoides, L.—4.
107 Alliaria, L.—17.

Cheiranthus.
109 *Cheiri*, L.

Matthiola.
110 incana, Br.—1.
111 sinuata, Br.—3.

Hesperis.
112 *matronalis*, L.

Brassica.
113 oleracea, L.—5.
114 campestris, L.—14.
114* *Rapa*, L.
115 *Napus*, L.

Sinapis.
116 arvensis, L.—18.
117 alba, L.—15.
118 nigra, L.—13.
119 incana, L.—C.
120 tenuifolia, Br.—13.
121 muralis, Br.—6.
122 Cheiranthus, Koch.—C.
b. monensis, Bab.—6.

Raphanus.
123 Rhaphanistrum, L.—18.
124 maritimus, Sm.—7.

V. RESEDACEÆ.

Reseda.
125 luteola, L.—16.
126 lutea, L.—12.
127 *fruticulosa*, L.
b. *alba*, L.

VI. CISTACEÆ.

Helianthemum.
128 vulgare, Gært.—16.
129 polifolium, Pers.—1.
130 canum, Dun.—4.
131 guttatum, Mill.—I. C.
b. Breweri, Plch.—1.

VII. VIOLACEÆ.

Viola.
132 palustris, L.—18.
133 odorata, L.—9.
b. alba, Aut.
134 hirta, L.—14.
135 canina (Ger.) Sm.—18.
a. sylvatica, Fries.
b. flavicornis, E. B. S.
135*flavicornis, Sm.—14.
135*lactea, Sm. 3 ?
135*stagnina, Kit.—3 ?
136 tricolor, L.—18.
b. arvensis, Mur.
c. Curtisii, Mack.—1.
137 lutea, Huds.—14.
b. amœna, Syme.
? Curtisii, Forst.—3.

VIII. DROSERACEÆ.

Drosera.
138 rotundifolia, L.—18.
139 intermedia, Hayn.—13.
140 anglica, Huds.—13.
b. obovata, Mert.

IX. POLYGALACEÆ.

Polygala.
141 vulgaris, L.—18.
b. depressa, Wend.
141*calcarea, Schultz.—2.
141*uliginosa, Reich.—1.

X. FRANKENIACEÆ.

Frankenia.
142 lævis, L.—3.

XI. ELATINACEÆ.

Elatine.
143 hexandra, DC.—9.
144 Hydropiper, L.—3.

XII. CARYOPHYLLACEÆ.

Dianthus.
145 prolifer, L.—3.
146 Armeria, L.—12.
147 *plumarius*, L.
148 *Caryophyllus*, L.
149 cæsius, Sm.—1.
150 deltoides, L.—12.
b. glaucus, L.

Saponaria.
151 *officinalis*, L.
b. *hybrida*, Mill.

Silene.
153 inflata, Sm.—17.
153*maritima, With.—17.
154 Otites, Sm.—1.
155 anglica, L.—14.
b. quinquevulnera, L.—C.
156 nutans, L.—8.
156*italica, Pers.—1.
157 noctiflora, L.—9.
158 conica, L.—4.
159 acaulis, L.—6.

Lychnis.
160 alpina, L.—2.
161 Viscaria, L.—5.
162 Flos-cuculi, L.—18.
163 diurna, Sibth.—18.
164 vespertina, Sibth.—17.
165 Githago, Lam.—18.

Moenchia.
166 erecta, Sm.—11.

Sagina.
167 procumbens, L.—18.
168 maritima, Don.—14?
b. densa, Jord.
169 apetala, L.—14.
b. debilis, Jord.
169*ciliata, Fries.—3.
170 saxatilis, Wimm.—2.
170*subulata, Wimm.—15.
171 nodosa, Mey.—18.

Spergula.
172 arvensis, L.—18.

Honckeneja.
173 peploides, Ehrh.—18.

Spergularia.
174 marina, Camb.—18.
b. media.
174*rupestris, Camb.—C.
175 rubra, St. Hil.—17.

Arenaria.
176 ciliata, L.—I.
177 norvegica, Gunn.—1.
178 serpyllifolia, L.—18.
179 tenuifolia, L.—5.
b. viscosa, Pers.
180 verna, L.—12.
b. Gerardi, Willd.
181 rubella, Hook.—2.
181*uliginosa, Schl.—1.
182 trinervis, L.—16.

Holosteum.
183 umbellatum, L.—1.

Stellaria.
184 nemorum, Linn.—12.
185 media, With.—18.
186 Holostea, L.—18.
187 glauca, With.—13.
188 graminea, L.—18.
189 uliginosa, Murr.—18.
190 cerastoides, L.—2.

Cerastium.
191 aquaticum, L.—10.
192 glomeratum, Thuil.—18.
193 triviale, Link.—18.
194 semidecandrum, L.—16.
b.? pumilum, Curt.
194*tetrandrum, Curt.—16.
195 arvense, L.—13.
b. strictum, L.—I.
196 alpinum, L.—4.
197 latifolium, L.—4.
b. nigrescens, Edm.—1.

Cherleria.
198 sedoides, L.—4.

XIII. LINACEÆ.

Linum.
199 *usitatissimum*, L.
200 perenne, L.—5.
201 angustifolium, Huds.—8.
202 catharticum, L.—18.

Radiola.
203 millegrana, Sm.—18.

XIV. MALVACEÆ.

Malva.
204 moschata, L.—16.
205 sylvestris, L.—17.
206 rotundifolia, L.—14.

Althæa.
208 officinalis, L.—8.
209 *hirsuta*, L.

Lavatera.
210 arborea, L.—4.

XV. TILIACEÆ.

ilia.
211 parvifolia, Ehrb.—8?
212 *intermedia*, DC.
213 *grandiflora*, Ehrb.
b. *corallina*, Sm.

XVI. HYPERICACEÆ.

ypericum.
214 Androsæmum, L.—15.
215 perforatum, L.—17.
216 dubium, Leers.—15.
b. maculatum, Bab.
217 quadrangulum, L.—17.
218 humifusum, L.—16.
219 linariifolium, Vahl.—1.
220 pulchrum, L.—18.
221 hirsutum, L.—16.
222 montanum, L.—12.
223 elodes, L.—14.
224 *calycinum*, L.

XVII. ACERACEÆ.

cer.
225 campestre, L.—11.
226 *Pseudoplatanus*, L.

XVIII. GERANIACEÆ.

rodium.
227 maritimum, Sm.—10.
228 cicutarium, Sm.—18.
b. pimpinellæfolium.
228*moschatum, Sm.—2.
eranium.
229 *phæum*, L.
230 sylvaticum, L.—10.
231 pratense, L.—16.
232 pyrenaicum, L.—8.
233 rotundifolium, L.—5.
234 pusillum, L.—15.
235 molle, L.—18.
236 dissectum, L.—17.
237 columbinum, L.—16.
238 lucidum, L.—17.
239 robertianum, L.—18.
b. purpureum, Forst.
240 sanguineum, L.—16.
b. lancastriense, With.

XIX. BALSAMINACEÆ.

mpatiens.
241 *fulva*, Nutt.
242 Noli me-tangere, L.—2.

XX. OXALIDACEÆ.

xalis
243 Acetosella, L.—18.
244 *corniculata*, L.
244**stricta*, L.

XXI. CELASTRACEÆ.

conymus.
245 europæus, L.—14.

XXII. RHAMNACEÆ.

hamnus.
246 catharticus, L.—12.
247 Frangula, L.—13

XXIII. LEGUMINIFERÆ.

Spartium.
248 scoparium, L.—17.
Ulex.
249 europæus, L.—17.
b. strictus, Mack.—I.
250 nanus, Forst.—13.
b. Gallii, Planch.
Genista.
251 tinctoria, L.—14.
b. humifusa, "Dicks."
252 pilosa, L.—5.
253 anglica, L.—17.
Ononis.
254 arvensis, L.—17.
255 antiquorum, L.—16.
256 reclinata, L.—C.
Anthyllis.
257 vulneraria, L.—18.
b. Dillennii, Schult.
Medicago.
258 *sativa*, L.
258*sylvestris, Fries.—1.
259 falcata, L.—2.
260 lupulina, L.—18.
261 maculata, Sibth.—11.
262 denticulata, Willd.—5.
b. apiculata, Willd.
263 minima, Lam.—3.
Melilotus.
264 officinalis, Willd.—14.
264*arvensis, Wallr.—2.
265 vulgaris, Willd.—10.
Trigonella.
266 ornithopodioides, DC.-10.
Trifolium.
267 repens, L.—18.
268 subterraneum, L.—10.
269 orchroleucum, L.—2.
270 Molinerii, Balb.—1.
271 pratense, L.—18.
272 medium. L.—18.
273 maritimum, Huds.—6.
274 *stellatum*, L.
275 arvense, L.—17.
276 scabrum, L.—13.
277 striatum, L.—14.
277*Bocconi, Sav.—1.
278 glomeratum, L.—5.
278*strictum, L.—1.
279 suffocatum, L.—5.
280 fragiferum, L.—14.
281 procumbens, L.—18.
282 minus, Relh.—14.
282*filiforme, L.—17.
Lotus.
283 corniculatus, L.—18.
b. tenuis, W. K.—13.
284 major, Scop.—16.
285 angustissimus, L.—2.
b. hispidus, Desf.—2.
Astragalus.
286 glyciphyllos, L.—14.
287 hypoglottis, L.—9.
288 alpinus, L.—1.
Oxytropis.
289 uralensis, DC.—4.
290 campestris, DC.—1.
Ornithopus.
291 perpusillus, L.—16.
Arthrolobium.
292 ebracteatum, DC.—1.
Hippocrepis.
293 comosa, L.—10.
Onobrychis.
294 sativa, Lam.—8.
Vicia.
295 Orobus, DC.—8.
296 sylvatica, L.—17.
297 Cracca, L.—18.
298 sativa, L.—18.
b. angustifolia, R.—15.
299 lathyroides, L.—17.
300 lutea, L.—5.
301 sepium, L.—18.
302 bithynica, L.—7.
303 hirsuta. Koch.—18.
304 tetrasperma, Koch.—13.
b. gracilis, Lois.—4.
Lathyrus.
305 Aphaca, L.—5.
306 Nissolia, L.—6.
307 hirsutus, L.—1.
308 pratensis, L.—18.
309 palustris, L.—5.
310 sylvestris, L.—15.
311 maritimus, Bigel.—5.
Orobus.
312 tuberosus, L.—18.
b. tenuifolius, Roth.
313 niger, L.—2.

XXIV. ROSACEÆ.

Prunus.
314 spinosa, L.—17.
b. insititia, L.—14.
c. *domestica*, L.
315 Padus, L.—13.
316 Cerasus, L.—10.
316*avium, L. 16.
Spiræa.
317 Ulmaria, L.—18.
318 Filipendula, L.—13
319 *salicifolia*, L.
Dryas.
320 octopetala, L.—7.
b. depressa, Bab.—I.
Geum.
321 urbanum, L.—17.
b. intermedium, Eh.
322 rivale, L.—18.
Agrimonia.
323 Eupatoria, L.—16.
b. odorata, Mill.—4.
Sibbaldia.
324 procumbens, L.—5.
Potentilla.
325 fruticosa, L.—3.
326 rupestris, L.—1.
327 anserina, L.—18.

328 argentea, L.—13.
329 verna, L.—12.
330 alpestris, Hall.—4.
331 reptans, L.—16.
332 Tormentilla, Schk.—18.
b. nemoralis, Nestl.
333 Fragariastrum, Eh.—16.

Comarum.

334 palustre, L.—18.

Fragaria.

335 vesca, L.—18.
336 *elatior*, Ehrh.—6.

Rubus.

337 Chamæmorus, L.—11.
338 saxatilis, L.—14.
339 Idæus, L.—18.
b. Leesii, Bab.
340 fruticosus, Aut.—18.
(*Species Babingtonianæ.*)
3 suberectus, And.—9
4 fissus, Lindl.—1.
5 plicatus, W. & N.—12.
b. carinatus, Bab.
6 nitidus. Salt.—9.
b. confertus, Bab.
7 affinis, W. & N.—11.
b. lentiginosus, Lees.
8 latifolius, Bab.—3.
9 imbricatus Hort.—1.
10 incurvatus, Bab.—4.
11 rhamnifol., W. & N.—10.
12 Grabowskii, Weih.—1.
13 thyrsoideus, Wimm.—5.
b. argenteus, Lees.
c. macroanthus, Blox.
14 discolor, W. & N.—9.
b. macroanthus, Salt.
15 leucostachys, Sm.—9.
b. Leightonianus, Bab.
16 carpinifol., W. & N.—14.
b. umbrosus, Arrh.
17 villicaulis, W. & N.—9.
18 pampinosus, Lees—?
19 mucronatus, Blox.—4.
20 Salteri, Bab.—3.
b. calvatus, Blox.
21 macrophyl., W. & N.—11.
22 Sprengelii, Weihe.—8.
a. Borreri, Salt.
b. Sprengelii, W.
23 Bloxamii, Lees.—2
24 Hystrix, Weibe.—8.
25 Radula, Weihe.—11.
b. Lingua, Bab.
26 rudis, Weihe.—10.
b. Leightonii, Lees.
c. denticulatus, Bab.
d. Reichenbachii, W.
27 pallidus, Weihe.—11.
b. infestus, Bab.
28 Koehleri, Weihe.—9.
29 fusco-ater, Weihe?—9.
b. Colemanni, Blox.
c. aculeatus, Bab.
30 pyramidalis, Bab.
31 Guntheri, Weihe.—3.
32 hirtus, W. & N.—3.
b Menkii, Weihe.
c. foliosus, Weihe.
33 glandulosus, Salt.—8.
a. Bellardi, Weihe.—4.
b. fuscus, Bab.—3.
c. Lejeunii, Weihe.—5.
d. rosaceus, Weihe.—8.
34 scaber, Weihe.—4.
35 Balfourianus, Blox.—1.
b. tenuiarmatus, Lees.
36 corylifolius, Sm.—11.
a. sublustris, Lees.—8.
b. conjungens, Bab.—8.
c. purpureus, Bab.—5.
37 nemorosus, Hayne.—9.
a. glabratus, Bab.
b. pilosus, Bab.
c. bifrons, Vest,
d. ferox, Leight.
38 cæsius, L.—14.
b. tenuis, Salt.

Rosa.

341 spinosissima, L.—18.
342 hibernica, Sm.—1.
343 Wilsoni, Borr.—4.
344 involuta, Sm.—1.
345 Sabini, Woods.—11.
b. Doniana, Woods.
c. gracilis, Woods.
346 villosa, L—6.
347 tomentosa, Woods.—12.
348 inodora, Fries.—10.
349 micrantha, Sm.—8.
350 rubiginosa, L.—16?
350*sepium, Thuil.—2.
351 canina, L.—18.
b. sarmentacea, Woods.
c. surculosa, Woods.
d. dumetorum, Woods.
e. Fosteri, Sm.
f. bractescens, Woods.
g. cæsia, Sm.
352 systyla, Aut.—5.
353 arvensis, L.—14.

Sanguisorba.

354 officinalis, L.—14.

Poterium.

355 Sanguisorba, L.—15.
355*muricatum, Spach.—4.

Alchemilla.

356 vulgaris, L.—18.
357 alpina, L.—6.
358 arvensis, Lam.—18.

Mespilus.

359 *germanica*, L.

Cratægus.

360 Oxyacantha, L.—17.

Cotoneaster.

361 vulgaris, Lindl.—1.

Pyrus.

362 communis, L.—8?
363 Malus, L.—16.

365 Aria, Sm.—13.
b. fennica, Fr.—5.
c. scandica, Fr.—7.
366 Aucuparia, Gaert.—18.

XXV. ONAGRACEÆ.

Epilobium.

367 angustifolium, L.—18.
b. brachycarpum, Leigh
367*rosmarinifol., Haenk.—
368 hirsutum, L.—15.
369 parviflorum, Schreb.—1
370 montanum, L.—18.
370*lanceolatum, S. M.—3.
371 roseum, Schreb.—8.
372 palustre, L.—18.
373 tetragonum, L.—17.
b. obscurum, Schreb.
c. virgatum, Bab.
374 alpinum, L.—4.
b. anagallidifolium, La
374*alsinifolium, Vill.—8?

Œnothera.

375 *biennis*, L.

Isnardia.

376 palustris, L.—1.

Circæa.

377 lutetiana, L.—17.
b. intermedia, Angl.
378 alpina, L.—4.

XXVI. HALORAGIACEÆ

Hippuris.

379 vulgaris, L.—17.

Myriophyllum.

380 verticillatum, L.—10.
b. pectinatum, DC.
381 spicatum, L.—18?
382 alterniflorum, DC.—17.

Callitriche.

383 verna, L.—18.
384 platycarpa, Kutz.—17.
385 pedunculata, DC.—17.
b. sessilis.
386 autumnalis, L.—5.

Ceratophyllum.

387 demersum, L.—12.
a. oxyacanthum, Cham.
b. apiculatum, Cham.
388 submersum, L.—5.

XXVII. LYTHRACEÆ.

Lythrum.

389 hyssopifolium, L.—3.
390 Salicaria, L.—16.

Peplis.

391 Portula, L.—18.

XXVIII. TAMARISCACEÆ.

Tamarix.

392 *anglica*, Webb.

XXIX. CUCURBITACEÆ

Bryonia.

XX. PORTULACACEÆ.

NTIA.
94. fontana, L.—18.

XXI. ILLECEBRACEÆ.

ECEBRUM.
95 verticillatum, L.—1.
RIGIOLA.
96 littoralis, L.—1.
RNIARIA.
97 glabra, L.—3.
b. ciliata, Bab.
YCARPON.
98. tetraphyllum, L.—2.

XVII. SCLERANTHACEÆ

ERANTHUS.
99 annuus, L.—17.
00 perennis, L.—2.

XXXIII GROSSULARIACEÆ.

ES.
03 nigrum, L.—10?
04 rubrum, L.—12 ?
b. petræum, Sm.—5.
c. spicatum, Robs.
05 alpinum, L.—10.
06 *Grossularia*, L.

XXIV. CRASSULACEÆ.

LÆA.
07. muscosa, L.—2.
UM.
08. Rhodiola, DC.—10.
09 Telephium, L.—17 ?
b. purpureum, Tausch.
10 villosum, L.—7.
11 *dasyphyllum*, L.
12 anglicum, Huds.—15.
13 *album*, L.
b. *micranthum*, Haw.
14 acre, L.—18.
15 *sexangulare*, L.
16 reflexum, L.—11 ?
b. glaucum, Sm.
16*rupestre, L.—5.
16*Forsterianum, Sm.—3.
MPERVIVUM.
17 *tectorum*, L.
TYLEDON.
18 Umbilicus, L.—13.

XXV. SAXIFRAGACEÆ.

IFRAGA.
419 Geum, L.—1.
b. dentata.
c. polita.
d. elegans, Mack.
e. gracilis, Mack.
420 hirsuta, L.—1.
421 umbrosa, L.—1.
b. punctata, Haw.
c. serratifolia, Mack.
d. duplicato-serrata.
422 stellaris, L.—10.
423 nivalis, L.—4.
424 Hirculus, L.—7.
425 aizoides, L.—8.
426 oppositifolia, L.—8.
427 granulata, L.—13.
428 cernua, L.—1.
429 rivularis, L.—2.
430 tridactylites, L.—15.
431 hypnoides, L.—14.
b. platypetala, Sm.
c. leptophylla, Don.
d. denudata, Don.
e. elongella, Sm.
f. lætevirens, Don.
431*hirta, Sm.—1.
431*affinis, Don.—1.
432 cæspitosa, L.—2.
b. decipiens, Sm.
c. incurvifolia, Don.
432*pedatifida, Sm.—1.
CHRYSOSPLENIUM.
434 oppositifolium, L.—18.
435 alternifolium, L.—15.
PARNASSIA.
436 palustris, L.—16.

XXXVI. ARALIACEÆ.

ADOXA.
437 moschatellina, L.—16.
HEDERA.
438 Helix, L.—18.

XXXVII. CORNACEÆ.

CORNUS.
439 sanguinea, L.—12.
440 suecica, L.—5.

XXXVIII. UMBELLIFERÆ.

HYDROCOTYLE.
441 vulgaris, L.—18.
SANICULA.
442 europæa, L.—17.
ASTRANTIA.
443 *major*, L.
ERYNGIUM.
444 maritimum, L.—16.
445 *campestre*, L.
CONIUM.
446 maculatum, L.—18.
PHYSOSPERMUM.
447 cornubiense, Hook.—1.
SMYRNIUM.
448 Olusatrum, L.—15.
CICUTA.
449 virosa, L.—14 ?
APIUM.
450 graveolens, L.—15.
PETROSELINUM.
451 *sativum*, Hoffm.
452 segetum, Koch.—8.
TRINIA.
453 vulgaris, DC.—2,
HELOSCIADIUM.
454 nodiflorum, Koch.—15.
b. repens, Koch.
455 inundatum, Koch.—1
SISON.
456 Amomum, L.—12.
ÆGOPODIUM.
457 Podagraria, L.—16.
CARUM.
458 *Carui*, L.
459 verticillatum, Koch.—5.
460 Bulbocastanum, K.—2.
BUNIUM.
461 flexuosum, With.—18.
PIMPINELLA.
462 Saxifraga, L.—17.
463 magna, L.—9.
SIUM.
464 latifolium, L.—11.
465 angustifolium, L.—14.
BUPLEURUM.
466 tenuissimum, L.—8.
467 aristatum, Barth.—1.
468 *falcatum*, L.
469 rotundifolium, L.—8.
ŒNANTHE.
470 fistulosa, L.—15.
471 pimpinelloides, L.—4.
471*Lachenalii, Gmel.—15.
472 silaifolia, Bieb ?—5.
473 crocata, L.—16.
474 Phellandrium, Lam.—12.
474*fluviatilis, Colem.—6.
ÆTHUSA.
475 Cynapium, L.—15.
FŒNICULUM.
476 vulgare, Gærtn.—6.
SESELI.
477 Libanotis, Koch.—3.
LIGUSTICUM.
478 Scoticum, L.—7.
SILAUS.
479 pratensis, Bess.—13.
MEUM.
480 athamanticum, Jacq.—9.
CRITHMUM.
481 maritimum, L.—7.
ANGELICA.
482 sylvestris, L.—18.
PEUCEDANUM.
483 officinale, L.—1.
484 palustre, Mœnch.—4
485 *Ostruthium*, Koch
PASTINACA.
486 sativa, L.—10.
HERACLEUM
487 Sphondylium, L.—18.
TORDYLIUM.
488 maximum, L.—1.
DAUCUS.
489 Carota, L.—18.
490 maritimus, With.—5.
CAUCALIS.
491 daucoides, L.—7.
492 *latifolia*, L.
TORILIS.
493 Anthriscus, Gærtn.—16.
494 infesta, Spr.—10.

495 nodosa, Gærtn.—13.
Scandix.
496 Pecten, L.—16.
Anthriscus.
497 vulgaris, Pers.—16.
498 sylvestris, Hoffm.—18.
499 *Cerefolium*, Hoffm.
Chærophyllum.
500 temulentum, L.—17.
Myrrhis.
501 odorata, Scop.—14?
Coriandrum.
502 *sativum*, L.

XXXIX. LORANTHACEÆ.

Viscum.
503 album, L.—8.

XL. CAPRIFOLIACEÆ.

Sambucus.
504 nigra, L.—14.
505 Ebulus, L.—16.
Viburnum.
506 Opulus, L.—17.
507 Lantana, L.—8.
Lonicera.
508 Periclymenum, L.—18.
509 *Caprifolium*, L.
510 *Xylosteum*, L.
Linnæa.
511 borealis, Gronov.—4.

XLI. RUBIACEÆ.

Rubia.
512 peregrina, L.—6.
Galium.
513 verum, L.—18.
514 cruciatum, With.—16.
515 palustre, L.—18.
b. elongatum, Pres.—3.
516 uliginosum, L.—15.
517 saxatile, L.—18.
518 erectum, Huds.—?
b. cinereum, Sm.
519 Mollugo, L.—13.
b. scabrum, "With."
c. insubricum, Gaud.
d. aristatum, "L."
520 sylvestre, Poll.—12.
b. commutatum, Jord.
c. montanum, Vill.
521 anglicum, Huds.—4.
522 tricorne, With.—9.
523 Aparine, L.—18.
524 Vaillantii, DC.—1.
525 boreale, L.—10.
Sherardia.
526 arvensis, L.—17.
Asperula.
527 odorata, L.—18.
528 cynachica, L.—9.

XLII. VALERIANACEÆ.

Centranthus.
529 *ruber*, DC.

Valeriana.
531 dioica, L.—15.
532 officinalis, L.—18.
b. sambucifolia, Mik.
533 *pyrenaica*, L.
Fedia.
534 olitoria, Vahl.—18.
535 *carinata*, *Stev.*
536 Auricula, DC.—7.
537 dentata, Bieb.—15.
b. mixta, Vahl.

XLIII. DIPSACEÆ.

Dipsacus.
539 sylvestris, L.—15.
540 pilosus, L.—9.
Scabiosa.
541 succisa, L.—18.
542 columbaria, L.—14.
Knautia.
543 arvensis, Coult.—18.
b. integrifolia.

XLIV. COMPOSITÆ.

Tragopogon.
544 pratensis, L.—15.
b. minor, Fr.
545 porrifolius, L.—5.
Helminthia.
546 echioides, Gærtn.—12.
Picris.
547. hieracioides, L.—10.
Thrincia.
548 hirta, Roth.—15.
Apargia.
549 hispida, Willd.—15.
550 autumnalis, Willd.—18.
b. taraxaci, Willd.?
Hypochœris.
551 glabra, L.—12.
552 maculata, L.—4.
553 radicata, L.—18.
Lactuca.
554 virosa, L.—11.
555 Scariola, L.—3.
556 saligna, L.—5.
557 muralis, Less.—12.
Sonchus.
558 palustris, L.—2.
559 arvensis, L.—18.
560 asper, Hoffm.—18.
561 oleraceus, L.—18.
Mulgedium.
562 alpinum, Less.—1.
Crepis.
563 virens, L.—18.
564 biennis, L.—6.
566 succisæfolia, Tausch.—5.
567 paludosa, Mœnch.—13.
Hieracium.
568 Pilosella, L.—18.
b. pilosissimum.
569 *aurantiacum*, L.
(*Species Backhousianæ*)
3 alpinum, L.—1.
4 holosericeum, Back.—3.
5 eximium, Back.—2.
b. tenellum.
6 calenduliflorum, B.—1.
7 gracilentum, Back.—1.
8 globosum, Back.—1.
9 nigrescens, Willd.—2.
10 lingulatum, Back.—2.
11 senescens, Back.—1.
12 chrysanthum, Back.—4.
b. microcephalum.
13 anglicum, Fries.—5.
b. amplexicaule.
c. acutifolium.
14 iricum, Fries.—6.
15 pallidum, Fries.—11.
16 lasiophyllum, Koch.—2.
17 Gibsoni, Back.—1.
18 argenteum, Fries.—4.
19 nitidum, Back.—1.
20 aggregatum, Back.—1.
21 murorum, L.—18?
b. rotundatum.
22 cæsium, Fries.—10?
22 *obtusifolium, —?
23 flocculosum, Back.—1.
24 vulgatum, Fries.—18?
b. cinereum.
c. rubescens.
d. maculatum.
e. nemorosum.
f. montanum.
g. macrocephalum.
25 gothicum, Fries.—4.
b. latifolium.
26 tridentatum, Fries.—10.
27 prenanthoides, Vill.—5.
28 strictum, Fries.—5.
29 umbellatum, L.—15.
b. filifolium.
30 crocatum, Fries.—3.
31 rigidum, Fries.—6.
32 corymbosum, Fries.—2.
33 boreale, Fries.—16.
Borkhausia.
585 fœtida, DC.—3.
586 taraxacifolia, DC.—3.
587 *setosa*, DC.
Taraxacum.
588 officinale, Wigg.—18.
b. lævigatum, DC.
c. erythrospermum, A
d. palustre, DC.—18.
Arnoseris.
589 pusilla, Gærtn.—6.
Lapsana.
590 communis, L.—18.
Cichorium.
591 Intybus, L.—16.
Arctium.
592 Lappa, L.—18.
a. majus, Schk.
b. intermedium, Lange
c. minus, Schk.

d. tomentosum, Pers.
e. pubens, Bab.
SAUSSUREA.
593 alpina, DC.—7.
SERRATULA.
594 tinctoria, L.—13.
CARDUUS.
595 nutans, L.—14.
596 acanthoides, L.—16.
597 tenuiflorus, Curt.—15.
598 *Marianus*, L.
599 lanceolatus, L.—18.
600 eriophorus, L.—10.
601 palustris, L.—18.
602 arvensis, Curt.—18.
b. setosus, (Bab.)
603 Forsteri, Bab.—2.
604 pratensis, Huds.—8.
605 tuberosus, L.—1.
606 acaulis, L.—7.
607 heterophyllus, L.—13.
ONOPORDUM.
608 Acanthium, L.—14.
CARLINA.
609 vulgaris, L.—16.
CENTAUREA.
610 nigrescens, Angl.—10.
611 nigra, L.—18.
612 Cyanus, L.—18.
613 Scabiosa, L.—15.
614 Isnardi, L.—C.
615 Calcitrapa, L.—4.
616 *solstitialis*, L.
BIDENS.
617 cernua, L.—16.
618 tripartita, L.—16.
EUPATORIUM.
619 cannabinum, L.—17.
CHRYSOCOMA.
620 Linosyris, L.—2.
DIOTIS.
621 maritima, Cass.—5.
TANACETUM.
622 vulgare, L.—18.
ARTEMISIA.
623 campestris, L.—1.
624 maritima, L.—15.
b. gallica, Willd.
625 Absinthium, L.—14.
626 vulgaris, L.—18.
GNAPHALIUM.
627 dioicum, L.—17.
b. hyperboreum, Wch.
628 *margaritaceum*, L.
629 luteo-album, L.—C.
630 sylvaticum, L.—18.
630*norvegicum, Gunn.—1.
631 supinum, L.—4.
632 uliginosum, L.—18.
FILAGO.
633 gallica, L.—1.
634 minima, Fries.—17.
635 germanica, L.—17.
635*apiculata, G. Sm.—5.
635*spathulata, Presl.—3.

PETASITES.
636 vulgaris, Desf.—16.
TUSSILAGO.
637 Farfara, L.—18.
ERIGERON.
638 alpinus, L.—1.
639 acris, L.—13.
640 *canadensis*, L.
ASTER.
641 Tripolium, L.—18.
SOLIDAGO.
642 Virgaurea, L.—18.
SENECIO.
643 vulgaris, L.—18.
644 sylvaticus, L.—18.
645 viscosus, L.—12.
646 *squalidus*, L.
647 erucæfolius, L.—14.
648 Jacobæa, L.—18.
648*aquaticus, Huds.—18.
649 paludosus, L.—1?
650 saracenicus, L.—10.
CINERARIA.
651 palustris, L.—2.
652 campestris, Retz.—5.
b. maritima, Aut.
DORONICUM.
653 *Pardalianches*, L.
654 *platagineum*, L.
INULA.
655 Helenium, L.—10.
656 Conyza, DC.—11.
657 crithmoides, L.—6.
PULICARIA.
658 dysenterica, Gært.—15.
659 vulgaris, Gært.—4.
BELLIS.
660 perennis, L.—18.
CHRYSANTHEMUM.
661 segetum, L.—18.
662 Leucanthemum, L.—18.
PYRETHRUM.
663 Parthenium, Sm.—17.
664 inodorum, Sm.—18.
b. maritimum, Sm.—?
MATRICARIA.
665 Chamomilla, L.—14.
ANTHEMIS.
667 nobilis, L.—13.
668 arvensis, L.—14.
669 Cotula, L.—15.
ACHILLEA.
671 Ptarmica, L.—18.
672 Millefolium, L.—18.

XLV. CAMPANULACEÆ.

CAMPANULA.
675 rotundifolia, L.—18.
676 patula, L.—7.
677 Rapunculus, L.—4.
678 latifolia, L.—14.
679 rupunculoides, L.—5.
680 Trachelium, L.—10.
681 glomerata, L.—12.
682 *persicifolia*, L.
WAHLENBERGIA.
683 hederacea, Reich.—10.
SPECULARIA.
684 hybrida, A. DC.—8.
PHYTEUMA.
685 orbiculare, L.—2.
686 spicatum, L.—1.
JASIONE.
687 montana, L.—16.
LOBELIA.
688 urens, L.—1.
689 Dortmanna, L.—9.

XLVI. ERICACEÆ.

ERICA.
690 Tetralix, L.—18.
b. Macksii, Hook.—I.
c Watsoni (Benth.)—1.
691 ciliaris, L.—2.
692 cinerea, L.—18.
693 mediterranea, L.—I.
694 vagans, L.—1.
CALLUNA.
695 vulgaris, Salisb.—18.
MENZIESIA.
696 cærulea, Sm.—1.
697 polifolia, Juss.—I.
AZALEA.
698 procumbens, L.—4.
ANDROMEDA.
699 polifolia, L.—13.
ARBUTUS.
700 alpina, L.—4.
701 Uva-ursi, L.—8.
702 Unedo, L.—I.
VACCINIUM.
703 Myrtillus, L.—18.
704 uliginosum, L.—6.
705 Vitis-Idæa, L.—14.
706 Oxycoccos, L.—16.
PYROLA.
707 rotundifolia, L.—8.
b. maritima; Ken.
708 media, Swartz.—12.
709 minor, L.—14.
710 secunda, L.—7.
711 uniflora, L.—3.
MONOTROPA.
712 Hypopitys, L.—9.

XLVII. ILICACEÆ.

ILEX.
713 Aquifolium, L.—18.

XLVIII. JASMINACEÆ.

LIGUSTRUM.
714 vulgare, L.—10.
FRAXINUS.
715 excelsior, L.—17.
b. heterophylla, Vahl.

XLIX. APOCYNACEÆ.

VINCA.
716 minor, L.—7.
717 *major*, L.

L. GENTIANACEÆ.

Gentiana.
718 verna, L.—3.
719 Pneumonanthe, L.—9.
720 nivalis, L.—1.
721 Amarella, L.—17.
b. germanica, Willd.
722 campestris, L.—18.
Cicendia.
723 filiformis, Reich.—3.
723* Candollei, Griseb.—C.
Erythræa.
724 Centaurium, Pers.—18.
b. littoralis, Hook.—9.
c. pulchella, Hook.—10.
d. latifolia, Sm.—1.
Chlora.
725 perfoliata, L.—10.
Villarsia.
726 nymphæoides, Vent.—4.
Menyanthes.
727 trifoliata, L.—18.
Polemonium.
728 cæruleum, L.—4.

LI. CONVOLVULACEÆ.

Convolvulus.
729 arvensis, L.—15.
730 sepium, L.—16.
731 Soldanella, L.—13.
Cuscuta.
732 europæa, L.—8.
733 *Epilinum*, Weih.
734 Epithymum, Sm.—11.
735 *Trifolii*, Bab.

LII. SOLANACEÆ.

Hyoscyamus.
736 niger, L.—17.
Solanum.
737 nigrum, L.—11.
738 Dulcamara, L.—17.
Atropa.
739 Belladonna, L.—12.

LIII. SCROPHULARIACEÆ.

Verbascum.
740 Thapsus, L.—16.
741 Lychnitis, L.—5.
742 floccosum, W. et K.—1.
743 nigrum, L.—7.
744 Blattaria, L.—?
745 virgatum, With.—5.
Veronica.
746 spicata, L.—4.
b. hybrida, L.
747 arvensis, L.—18.
748 verna, L.—1.
749 triphyllos, L.—2
750 serpyllifolia, L.—18.
b. humifusa, Dicks.—5.
751 alpina, L.—2.
752 saxatilis, L.—2.
753 scutellata, L.—18.
b. parmularia, "Trat."
754 Anagallis, L.—17.
755 Beccabunga, L.—18.
756 officinalis, L.—18.
b. hirsuta, Hopk.
757 montana, L.—16.
758 Chamædrys, L.—18.
759 hederifolia, L.—18.
760 agrestis, L.—18.
761 polita, Fries.—15.
b. grandiflora.
762 *Buxbaumii*, Ten.
Bartsia.
763 alpina, L.—3.
764 viscosa, L.—6.
765 Odontites, Huds.—18.
b. rotundata, (Ball).
c. elegans, (Ball).
Euphrasia.
766 officinalis, L.—18.
b. gracilis, Fr.
Rhinanthus.
767 Crista-galli, L.—18.
b. major, Anglor.—8.
Melampyrum.
768 cristatum, L.—3.
769 arvense, L.—2.
770 pratense, L.—18.
b. montanum, Johnst.
771 sylvaticum, L.—7.
Pedicularis.
772 palustris, L.—18.
773 sylvatica, L.—18.
Scrophularia.
774 nodosa, L.—18.
774* Ehrharti, Stev.—7.
775 aquatica, L.—14.
776 Scorodonia, L.—1.
777 vernalis, L.—4.
Digitalis.
778 purpurea, L.—18.
Antirrhinum.
779 *majus*, L.
780 Orontium, L.—7.
Linaria.
781 *Cymbalaria*, Mill.
782 spuria, Mill.—8.
783 Elatine, Mill.—10.
784 repens, Ait.—8.
b. sepium, Allm.
785 vulgaris, Mill.—16.
b. speciosa, Bromf.
786 pelisseriana, Mill.—C.
787 minor, Desf.—12.
Limosella.
788 aquatica, L.—12.
Sibthorpia.
789 europæa, L.—3.
Mimulus.
789* *luteus*, L.

LIV. OROBANCHACEÆ.

Orobanche.
790 major, Angl.—12.
791 caryophyllacea, Sm.—1.
792 elatior, Sutt.—10.
793 minor, Sutt.—7.
793* amethystea, Thuil.—1.
793* Picridis, F. Schultz.—3.
793* hederæ, Duby.—5.
794 rubra, Sm.—6.
795 cærulea, Vill.—4.
795* arenaria, "Bork."—C.
796 *ramosa*, L.
Lathræa.
797 squamaria, L.—14.

LV*. VERBENACEÆ.

Verbena.
798 officinalis, L.—12.

LV. LAMIACEÆ.

Salvia.
799 verbenaca, L.—13.
b. clandestina, L.
800 pratensis, L.—1.
Lycopus.
801 europæus, L.—17.
Mentha.
802 rotundifolia, L.—11.
803 sylvestris, L.—13.
b. *viridis*, L.
805 piperita, L.—14.
806 aquatica, L.—18.
b. citrata, Ehrh.
807 sativa, L.—16.
b. rubra, Sm.
c. gentilis, Sm.
d. acutifolia, Sm.
e. pratensis, "Sole."
808 arvensis, L.—18.
b. agrestis, Sm.
809 Pulegium, L.—12.
Thymus.
810 Serpyllum, L.—18.
b. Chamædrys, Fr.
Origanum.
811 vulgare, L.—16.
Calamintha.
812 Acinos, Clairv.—15.
813 Nepeta, Clairv.—5.
814 officinalis, Angl.—12.
814* sylvatica, Bromf.—1.
815 Clinopodium, Spen.—15.
Melissa.
816 *officinalis*, L.
Melittis.
817 Melissophyllum, L.—4.
Teucrium.
818 Scorodonia, L.—18.
819 Scordium, L.—5.
b. scordioides, Schreb.
820 Botrys, L.—1.
821 *Chamædrys*, L.
Ajuga.
822 reptans, L.—18.
823 pyramidalis, L.—4.
824 Chamæpitys, Schreb.—3.
Ballota.
825 nigra, L.—14.
b. ruderalis, Fries.

eonurus.
826 *Cardiaca*, L.
amium.
827 Galeobdolon, Crantz.—10.
828 album, L.—15.
829 *maculatum*, L.
b. *lævigatum*, L.
830 amplexicaule, L.—18.
830*intermedium, Fries.—5.
831 purpureum, L.—18.
b. incisum, Willd.—18.
aleopsis.
832 Ladanum, L.—14.
833 ochroleuca, Lam.—7.
834 Tetrahit, L.—18.
b. bifida, Boen.
835 versicolor, Curt.—15.
tachys.
836 Betonica, Benth.—15.
837 palustris, L.—18
b. ambigua, Sm.—4.
838 sylvatica, L.—18.
839 germanica, L.—3.
840 arvensis, L.—18.
lechoma.
841 hederacea, L.—18.
epeta.
842 Cataria, L.—13.
arrubium.
843 vulgare, L.—13.
runella.
844 vulgaris, L.—18.
cutellaria.
845 galericulata, L.—18.
846 minor, L.—14.

LVI. BORAGINACEÆ.

yosotis.
847 palustris, With.—15.
b. strigulosa, Reich.
848 repens, Don.—16.
849 cæspitosa, Schultz.—18.
850 alpestris, Schmid.—2.
851 sylvatica, Ehrh.—13.
852 arvensis, Hoffm.—18.
853 collina, Hoffm.—16.
854 versicolor, Lehm.—18.
ithospermum.
855 officinale, L.—17.
856 arvense, L.—18.
857 purpurocæruleum, L.—4.
ertensia.
858 maritima, Don.—8.
ymphytum.
859 officinale, L.—15.
860 tuberosum, L.—7.
orago.
861 *officinalis*, L.
ycopsis.
862 arvensis, L.—18.
nchusa.
863 *officinalis*, L.
864 sempervirens, L.—?
sperugo.
865 procumbens, L.—6.

25

Cynoglossum.
866 officinale, L.—14.
867 sylvaticum, Hænk.—3.
Pulmonaria.
868 angustifolia, L—1.
868**officinalis*, L.
Echium.
869 vulgare, L.—18.
870 violaceum, L.—C.

LVII. PINGUICULACEÆ.

Pinguicula.
871 grandiflora, Lam.—I.
872 vulgaris L.—18.
873 alpina, L.—2.
874 lusitanica, L.—8.
Utricularia.
875 vulgaris, L.—17.
876 intermedia, Hayne.—7.
877 minor, L.—18.

LVIII. PRIMULACEÆ.

Primula.
878 vulgaris, Huds.—18.
b. elatior, Ang. plur.
879 elatior, Jacq.—2.
880 veris, L.—17.
881 farinosa, L.—5.
882 scotica, Hook.—2.
Cyclamen.
883 *hederæfolium*, Willd.
Trientalis.
884 europæa, L.—9.
Hottonia.
885 palustris, L.—11.
Lysimachia.
886 vulgaris, L.—16.
887 thyrsiflora, L.—6.
888 nummularia, L.—10.
889 nemorum, L.—17.
Anagallis.
890 arvensis, L.—16.
b. cærulea, Aut.—12.
891 tenella, L.—17.
Centunculus.
892 minimus, L.—13.
Samolus.
893 Valerandi, L.—16.
Glaux.
894 maritima, L.—18.

LIX. PLUMBAGINACEÆ.

Armeria.
895 maritima, Aut.—18.
a. maritima, Boiss.
b. scotica, Boiss.
c. pubescens, Link.
d. duriuscula, Bab.
896 plantaginea, Willd.—C.
Statice.
897 Limonium, L.—13.
898 Bahusiensis, Fr.—9.
899 binervosa, G. E. Sm.—9.
a. occidentalis, Lloyd.
b. Dodartii, Gir.
900 caspia, Willd.—1.

LX. PLANTAGINACEÆ.

Plantago.
901 major, L.—18.
902 media, L.—15.
903 lanceolata, L.—18.
904 maritima, L.—18.
905 Coronopus, L.—18.
Littorella.
906 lacustris, L.—18.

LXI. AMARANTHACEÆ.

Amaranthus.
907 *Blitum*, L.

LXII. CHENOPODIACEÆ.

Chenopodium.
908 olidum, Curt.—9.
909 polyspermum, L.—8.
b. acutifolium, E.B.
910 urbicum, L.—8.
b. intermedium, M.K.
911 rubrum, L.—14.
911*botryodes, Sm.—1.
912 murale, L.—10.
913 hybridum, L.—5.
914 album, L.—18.
b. viride, L.
915 ficifolium, Sm.—7.
916 glaucum, L.—5.
917 Bonus-Henricus, L.—14.
Atriplex.
918 portulacoides, L.—12.
919 pedunculata, L.—3.
920 arenaria, Woods.—4.
921 Babingtonii, Wds.—18.
922 hastata, L. 18.
a. patula, E. B.
b. deltoidea, Bab.
c. prostrata, Bab.
923 patula, L.—18.
a. angustifol. Sm.—18.
b.? erecta, Huds.?
924 littoralis, L.—12.
b. marina, L.—5.
Beta.
925 maritima, L.—14.
Salsola.
926 Kali, L.—15.
Schoberia.
927 maritima, Mey.—18.
928 fruticosa, Mey.—4.
Salicornia.
929 herbacea, L.—18.
b. procumbens, Sm.
930 radicans, Sm.—3.

LXIII. POLYGONACEÆ.

Polygonum.
931 Bistorta, L.—16.
932 viviparum, L.—8.
933 amphibium, L.—18.
934 lapathifolium, L.—16.
b. laxum, E.B.S.
935 Persicaria, L.—18.
936 mite, Schrank.—4.
937 Hydropiper, L.—17.

938 minus, Huds.—12.
939 aviculare, L.—18.
940 maritimum, L.—C.
940* Raii, Bab.—13.
941 Convolvulus, L.—18.
942 dumetorum, L.—4.

Rumex.
943 Hydrolapathum, H.—14.
944 crispus, L.—18.
944*aquaticus, L.—9.
945 pratensis, M. et K.—9.
946 *alpinus*, L.
947 obtusifolius, L.—18.
948 sanguineus, L.—16.
948*conglomeratus, Mur.—16.
949 pulcher, L.—7.
950 maritimus, L.—12.
b. palustris, Sm.—12.
951 Acetosa, L.—18.
952 Acetosella, L.—18.

Oxyria.
953 reniformis, Hook.—6.

LXIV. ELEAGNACEÆ.

Hippophæ.
954 rhamnoides, L.—4.

LXV. THYMELÆACEÆ.

Daphne.
955 Laureola, L.—12.
956 Mezereum, L.—6.

LXVI. SANTALACEÆ.

Thesium.
957 humifusum, DC.—5.

LXVII. ASARACEÆ.

Asarum.
958 europæum, L.—3.

Aristolochia.
959 *Clematitis*, L.

LXVIII. EMPETRACEÆ.

Empetrum.
960 nigrum, L.—15.

LXIX. EUPHORBIACEÆ.

Euphorbia.
961 Peplis, L.—3.
962 helioscopia, L.—18.
963 platyphylla, L.—5.
963*stricta, " Koch."—2.
964 hiberna, L.—1.
965 pilosa, L.—1.
966 *coralloides*, L.
967 *Esula*, L.
968 *Cyparissias*, K.
969 Paralias, L.—8.
970 portlandica, L.—7.
971 exigua, L.—14.
972 Peplus, L.—17.
973 *Lathyris*, L.
974 amygdaloides, L.—10.

Buxus.
975 sempervirens, L.—3.

Mercurialis.
976 perennis, L.—18.
b. ovata, Steud.
977 annua, L.—11.
b. ambigua, L. fil.

LXX. URTICACEÆ.

Urtica.
978 urens, L.—18.
979 dioica, L.—18.
980 *pilulifera*, L.
b. *Dodartii*, L.

Parietaria.
982 officinalis, L.—16.
a. diffusa, Koch.
b. erecta, Koch.

Humulus.
983 Lupulus, L.—12.

Ulmus.
984 montana, Sm.—18 ?
985 suberosa, Ehrh.—11.
a. campestris, Sm.
b. major, Sm.
c. glabra, Mill.

LXXI. AMENTIFERÆ.

Quercus.
988 Robur, L.—17.
a. pedunculata, W.—17.
b. intermedia, Don ?
c. sessiliflora, Sm.—17.

Fagus.
989 sylvatica, L.—11.

Carpinus.
990 Betulus, L.—5.

Corylus.
991 Avellana, L.—18.

Alnus.
992 glutinosa, L.—18.

Betula.
993 alba, L.—18.
b. pendula, Roth.
c. glutinosa, Wallr.
d. pubescens, Ehrh.
994 nana, L.—3.

Populus.
995 alba, L.—11.
996 canescens, Sm.—9.
997 tremula, L.—18.
998 *nigra*, L.

Salix.
999 pentandra, L.—12.
1000 *cuspidata*, Schultz.
1001 fragilis, L.—15.
a. decipiens, Hoffm.
b. fragilis, L.
c. Russelliana, Sm.
1002 alba, L.—16.
b. cærulea, Sm.
c. vitellina, Sm.
1003 *undulata*, Ehrh.
1004 triandra, L.—12.
a. triandra, Curtis.
b. Hoffmanniana, Sm.
c. amygdalina, Sm.
d. contorta, Crowe.
1004*acutifolia, Willd.—1.
1005 purpurea, L.—15.
a. purpurea, Sm.
b. Woollgariana, Bor
c. ramulosa, Borr.
d. Lambertiana, Sm.
e. Helix, L.
1006 rubra, Huds.—11.
b. Forbyana, Sm.
1007 viminalis, L.—15.
b. intricata, Leefe.
c. stipularis, Leefe.
1007*stipularis, Sm.—?
1008 Smithiana, Willd.—15.
a. Smithiana, Eng. Bo
b. rugosa, Sm.
c. ferruginea, And.
1009 acuminata, Sm.—15 ?
1010 cinerea, L.—18.
a. cinerea, Sm.
b. aquatica, Sm.
c. oleifolia, Sm.
1011 aurita, L.—18.
1012 caprea, L.—16.
b. sphacelata, Sm.
1013 nigricans, Fries.—7.
a. cotinifolia, Sm.
b. nigricans, Sm.
c. Forsteriana, Sm.
d. rupestris, Don.
e. Andersoniana, Sm.
f. damascena, Forbes.
g. petræa, And.
h. hirta, Sm.
1014 laurina, Sm.—?
a. propinqua, Borr.
b. tenuior, Borr.
c. laurina, Sm.
d. tenuifolia, L.
1015 phylicifolia, L.—8.
a. radicans, Sm.
b. Davalliana, Sm.
c. Weigeliana, Willd.
d. nitens, And. mss.
e. Croweana, Sm.
f. Dicksoniana, Sm.
g. laxiflora, Borr.
h. tetrapla, Walker.
i. Borreriana, Sm.
k. phillyreifolia, Borr.
1016 ambigua, Ehrh.—?
b. major, Bab.
c. spatulata, Willd.
1017 repens, L.—18.
a. repens, Eng. Bot.
b. fusca, Eng. Bot.
c. prostrata, Eng. Bot
d. ascendens, Sm.
e. incubacea, L.
f. argentea, Eng. Bot
1018 angustifolia, Wulf.—2.
1020 Doniana, Sm.—1.
1021 arbuscula, L.—4.
a. carinata, Sm.
b. prunifolia, Sm.
c. venulosa, Sm.

d. vacciniifolia, Sm.
1022 Lapponum, L.—6.
a. arenaria, Sm.
b. Stuartiana, Sm.
c. glauca, Sm.—1.
1023 lanata, L.—1.
1024 procumbens, Forb.—2.
1025 Myrsinites, L.—1.
a. arbutifolia, Sm.
b. Myrsinites, Sm.
1026 reticulata, L.—2.
1027 herbacea, L.—9.
Myrica.
1028 Gale, L.—17.

LXXII. CONIFERÆ.

Pinus.
1029 sylvestris, L.—3.
Juniperus.
1030 communis, L.—18.
b. nana, Willd.—8.
Taxus.
1031 baccata, L.—13.
b. fastigiata, Lindl.

LXXIII. ORCHIDACEÆ.

Goodyera.
1032 repens, Br.—3.
Spiranthes.
1033 autumnalis, Rich. 11.
1034 æstivalis, Rich.—1 or 2.
1035 cernua, (Rich ?)—I.
Neottia.
1036 Nidus-avis, Rich.—15.
Listera.
1037 cordata, Br.—15.
1038 ovata, Br.—17.
Epipactis.
1039 latifolia, Sw.—15.
1039*media, Fries.—8.
b. purpurata, Sm.
1039*atrorubens, Reich.—6.
1040 palustris, Sw.—15.
Cephalanthera.
1041 grandiflora, Bab.—9.
1042 ensifolia, Rich.—11.
1043 rubra, Rich.—3 ?
Epipogium.
1044 aphyllum, Sw.—1.
Corallorhiza.
1044*innata, Br.—4.
Orchis.
1045 Morio, L.—12.
1046 mascula, L.—18.
1047 laxiflora, Lam.—C.
1048 ustulata, L.—9.
1049 militaris, L.—1.
1049*tephrosanthos, V.—1.
1049*fusca, Jacq.—1.
1050 hircina, Scop.—2.
1051 pyramidalis, L.—13.
1052 latifolia, L.—18.
1053 maculata, L.—18.
Gymnadenia.
1054 Conopsea, Br.—18.
Habenaria.
1055 bifolia, Br.—11
b. chlorantha, Bab.—15.
1056 viridis, Br.—18.
1057 albida, Br.—12.
Aceras.
1058 anthropophora, Br.—4.
Herminium.
1059 Monorchis, Br.—5.
Ophrys.
1060 apifera, Huds.—10.
b. arachnites, Reich.—1.
1061 aranifera, Huds.—3.
b. fucifera, Sm.—1.
1062 muscifera, Huds.—10.
Malaxis.
1063 paludosa, Sw.—13.
Liparis.
1064 Loeselii, Rich.—2.
Cypripedium.
1065 Calceolus, L.—3.

LXXIV. IRIDACEÆ.

Iris.
1066 fœtidissima, L.—10.
1067 Pseudacorus, L.—18.
Sisyrinchium.
1067*anceps, Lam.—I.
Trichonema.
1068 Columnæ, Reich.—1.
Crocus.
1069 *vernus*, Willd.
1070 *nudiflorus*, Sm.

LXXV. AMARYLLIDACEÆ.

Narcissus.
1071 *poeticus*, L.
1072 *biflorus*, Curt.
1073 Pseudo-narcissus, L.—12.
Galanthus.
1074 *nivalis*, L.
Leucojum.
1075 æstivum, L.—3.

LXXVI. LILIACEÆ.

Lilium.
1076 *Martagon*, L.
Tulipa.
1077 *sylvestris*, L.
Fritillaria.
1078 Meleagris, L.—5.
Allium.
1079 Ampeloprasum, L.—C.
1080 Babingtonii, Borr.—I.
1081 Scorodoprasum, L.—7.
1082 oleraceum, L.—10.
b. carinatum, Sm.
1083 vineale, L.—15.
1084 sphærocephalum, L.—1.
1085 Schœnaprasum, L.—2.
b. sibiricum, L.—1.
1086 ursinum, L.—17.
1086*triquetrum, L.—C.
Gagea.
1087 lutea, Ker.—12.
Ornithogalum.
1088 pyrenaicum, L.—5.
1089 *nutans*, L.
1090 *umbellatum*, L.
Scilla.
1091 verna, Huds.—11.
1092 autumnalis, L.—4.
Hyacinthus.
1093 nonscriptus, L.—18.
Muscari.
1094 *racemosum*, Mill.
Anthericum.
1095 serotinum, L.—1.
Simethis.
1095*bicolor, Kunth.—1.
Asparagus.
1096 officinalis, L.—7.
Ruscus.
1097 aculeatus, L.—8.
Convallaria.
1098 *bifolia*, L.
1099 majalis, L.—13.
1100 verticillata, L.—2.
1101 multiflora, L.—11.
1102 Polygonatum, L.—5.

LXXVI.*TRILLIACEÆ.

Paris.
1103 quadrifolia, L.—15.

LXXVII. TAMACEÆ.

Tamus.
1104 communis, L.—12.

LXXVIII. MELANTHIACEÆ.

Colchicum.
1105 autumnale, L.—12.
Tofieldia.
1106 palustris, Huds.—5.

LXXIX. HYDROCHARIDACEÆ.

Hydrocharis.
1107 Morsus-ranæ, L.—11.
Anacharis.
1107**Alsinastrum*, Bab.
Stratiotes.
1108 *aloides*, L.

LXXX. ALISMACEÆ.

Alisma.
1109 Plantago, L.—17.
1110 ranunculoides, L.—17.
b. repens, Dav.
1111 natans, L.—5.
Actinocarpus.
1112 Damasonium, Br.—4.
Sagittaria.
1113 sagittifolia, L.—13.
Butomus.
1114 umbellatus, L.—11.
Triglochin.
1115 maritimum, L.—18.
1116 palustre, L.—18.
Scheuchzeria.
1117 palustris, L.—5.

LXXXI. FLUVIALES.

Potamogeton.
1118 densus, L.—13.
1119 flabellatus, Bab.—5.
1119*pectinatus, L.—15 ?
1119*filiformis, " Nolte."—5.
1120 pusillus, L.—17.
1120*gracilis, Fries ?—1.
1120*trichoides, Cham.—1.
1120*compressus, L.—?
1121 gramineus, L.—12.
1122 acutifolius, Link.—3.
1123 zosteræfolius, Schm.—5.
1124 crispus, L.—16.
1125 perfoliatus, L.—17.
1126 lucens, L.—14.
1127 prælongus, Wulf.—8.
1128 longifolius, Gay.—1.
1129 heterophyllus, Sb.—15.
1130 lanceolatus, Sm.
1131 rufescens, Schrad.—17.
1132 natans, L.—18 ?
1133 oblongus, Viv.—16.
1134 plantagineus, Ducr.—?

Ruppia.
1135 maritima, L.—14.
b. rostellata, Koch.

Zannichellia.
1136 palustris, L.—16.
b. pedicillata, Fr.

Zostera.
1137 marina, L.—15.
b. angustifolia, Roth.
1137*nana, Roth.—3.

Naias.
1137*flexilis, Rostk.—1.

LXXXII. ARACEÆ.

Lemna.
1138 minor, L.—18.
1139 gibba, L.—10.
1140 polyrhiza, L.—13.
1141 trisulca, L.—15.

Arum.
1142 maculatum, L.—13.

Acorus.
1143 Calamus, L.—9.

Sparganium.
1144 minimum. Fr.—?
1144*natans, L.—7.
1145 simplex. Huds.—17.
1146 ramosum, Huds.—18.

Typha.
1147 latifolia, L.—15.
1148 angustifolia, L—13.

LXXXIII. RESTIACEÆ.

Eriocaulon.
1149 septangulare, With.—1.

LXXXIV. JUNCACEÆ.

Juncus.
1150 filiformis, L.—2.
1151 conglomeratus, L.—18.
1151*effusus, L.—18.
1152 glaucus, Sibth.—15.
1152*diffusus, Hopp.—8.
1153 balticus, Willd.—3.
1154 maritimus, Sm.—14.
1155 acutus, L.—5.
1156 acutiflorus, Ehrh.—18.
1157 lamprocarpus, Eh.—18.
b. nigritellus, Don.
1158 obtusiflorus, Ehrh.—12.
1159 supinus, Moench.—18.
1160 compressus, Jacq.—13 ?
b. cœnosus, Bich.—17.
1162 bufonius, L.—18.
1163 squarrosus, L.—18.
1164 castaneus, Sm.—1.
1165 trifidus, L.—3.
1166 capitatus, Weigel.—C.
1167 biglumis, L.—2.
1168 triglumis, L.—8.

Luzula.
1169 sylvatica, Bich.—18.
1170 pilosa, Willd.—18.
b. Borreri, Bromf.
1171 Forsteri, DC.—5.
1172 campestris, " Br."—18.
1172*multiflora, Lej.—18.
1173 arcuata, Hook.—2.
1174 spicata, DC.—6.

Narthecium.
1175 ossifragum, Huds.—18.

LXXXV. CYPERACEÆ.

Cyperus.
1176 longus, L.—4.
1177 fuscus, L.—2.

Cladium.
1178 Mariscus, " Br."—14.

Schœnus.
1179 nigricans, L.—18.

Rhyncospora.
1180 alba, Vahl.—17.
1181 fusca, Sm.—3.

Blysmus.
1182 compressus, Panz.—13.
1183 rufus, Link.—10.

Scirpus.
1184 lacustris, L.—18.
b. glaucus, Sm.—12.
1184*carinatus, Sm.—2.
1185 Holoschœnus, L.—1.
1186 setaceus, L.—18.
1187 Savii, S. et M.—8.
1188 triqueter, L.—2.
1189 pungens, " Vahl."—C.
1190 maritimus, L.—17.
1191 sylvaticus, L.—16.
1192 palustris, L.—18.
1192*uniglumis, Link.—6.
1193 multicaulis, Sm.—18.
1193*Watsoni, Bab.—?
1194 pauciflorus, Lightf.—17.
1195 parvulus, R. et S.—1.
1196 cæspitosus, L.—18.
1197 acicularis, L.—15.
1198 fluitans, L.—16.

Eriophorum.
1199 vaginatum, L.—18.
1200 angustifolium, Rh.—18.
1201 latifolium, Hopp.—16.
1202 gracile, Koch.—2.

Elyna.
1203 caricina, M. et K.—3.

Carex.
1204 dioica, L.—17.
1205 pulicaris, L.—18.
1206 pauciflora, Lightf.—6.
1207 rupestris, All.—2.
1208 incurva, Lightf.—14.
1209 stellulata, Good.—18.
1210 leporina, L.—1.
1211 ovalis, Good.—18.
1212 curta, Good.—16.
b. Persoonii, Sieb.—5.
1213 elongata, L.—4.
1214 remota, L.—16.
1215 axillaris, Good.—8.
1216 Boenninghausiana.—4.
1217 intermedia, Good.—14.
1218 arenaria, L.—17.
1219 divisa, Huds.—7.
1220 muricata, L.—16.
1221 divulsa, Good.—9.
1222 vulpina, L.—16.
1223 teretiuscula, Good.—12.
b. Ehrhartiana, Hop.—2.
1223*paradoxa, Willd.—1.
1224 paniculata, L.—17.
1225 Vahlii, Schkh.—1.
1226 canescens, L.—1.
1227 atrata, L.—3.
1228 vulgaris, Fries.—18.
1229 rigida, Good.—10.
1230 aquatilis, Wahl.—1.
1231 stricta, Good.—12.
1232 acuta, L.—15.
1233 saxatilis, L.—3.
b. Grahami, Boott.—1.
1234 flava, L.—18.
b. Oederi, Aut.—16.
1235 extensa, Good.—15.
1236 pallescens, L.—17.
1237 fulva, Good.—18.
b. speirostachya, Sm.
1238 distans, L.—15.
1238*punctata, Ang.—2.
1239 binervis, Sm.—18.
1240 lævigata, Sm.—14.
1241 panicea, L.—18.
b. viginata, Taush.—3.
1242 depauperata, Good.—1.
1243 capillaris, L.—6.
1244 limosa, L.—12.
b. irrigua, Sm.—4.
1245 rariflora, Sm.—1.
1246 strigosa, Huds.—10.
1247 sylvatica, Huds.—15.
1248 pendula, Huds.—15.
1249 Pseudo-cyperus, L.—11.
1250 glauca, Scop.—18.
1251 præcox, Jacq.—16.
1251*montana, L.—2.

1252 pilulifera, L.—18.
1253 tomentosa, L.—1.
1254 clandestina, Good.—3.
1255 digitata, L.—5.
1256 filiformis, L.—12.
1257 hirta, L.—15.
1258 ampullacea, Good.—18.
1259 vesicaria, L.—16.
1260 paludosa, Good.—16.
b. Kochiana, DC.
1261 riparia, Curtis.—14.

LXXXVI. GRAMINA.

Leersia.
1262*oryzoides, Sw.—2.
Spartina.
1262 stricta, Roth.—5.
1263 alterniflora, Loisel.—1.
Cynodon.
1264 Dactylon, Pers.—2.
Digitaria.
1265 humifusa, Pers.—3.
Panicum.
1266 *Crus-galli*, L.
Setaria.
1267 viridis, Beauv.—2.
1268 *verticillata*, Beauv.
Phalaris.
1269 arundinacea, L.—18.
1270 *canariensis*, L.
Anthoxanthum.
1271 odoratum, L.—18.
Hierochloe.
1271*borealis, R. & S.—1.
Phleum.
1272 alpinum, Br. Fl.—2.
1273 pratense, L.—18.
b. nodosum, L.
1274 arenarium, L.—13.
1275 asperum, Jacq.—1.
1276 Boehmeri, "Wibel."—2.
Alopecurus.
1277 alpinus, Sm.—2.
1278 pratensis, L.—18.
1279 geniculatus, L.—18.
b. pronus, Mitt.
1280 fulvus, Sm.—5.
1281 bulbosus, L.—7.
1282 agrestis, L.—12.
Knappia.
1283 agrostidea, Sm.—1.
Gastridium.
1284 lendigerum, Gaud.—6.
Polypogon.
1285 littoralis, Sm.—3.
1286 monspeliensis, Desf.—3.
Milium.
1287 effusum, L.—16.
Apera.
1288 Spica-venti, Beauv.—4.
1288*interrupta, Beauv.—1.
Agrostis.
1289 setacea, Curtis.—3.
1290 canina, L.—18.
b. pumila, Lightf.
1292 alba, L.—18.
b. stolonifera, L.
Ammophila.
1293 arundinacea, Host.—17.
Arundo.
1294 Phragmites, L.—18.
1295 Calamagrostis, L.—9.
1296 Epigejos, L.—16.
1297 lapponica, Whal.?—I.
1298 stricta, Schrad.—1.
Sesleria.
1299 cærulea, Scop.—5.
Aira.
1300 cæspitosa, L.—18.
1301 alpina, L.—4.
1302 flexuosa, L.—18.
1303 caryophyllea, L.—18.
1304 præcox, L.—18.
1305 canescens, L.—3.
Lagurus.
1306 ovatus, L.—C.
Avena.
1307 fatua, L.—11
1308 *strigosa*, Schr b.
1309 pratensis, L.—16.
b. alpina, Sm.
1310 pubescens, L.—17.
1311 flavescens, L.—13.
Arrhenatherum.
1312 avenaceum, Beauv.—18.
Holcus.
1313 lanatus, L.—18.
1314 mollis, L.—18.
Triodia.
1315 decumbens, Beauv.—18.
Koeleria.
1316 cristata, Pers.—16.
Melica.
1317 uniflora, Retz.—15.
1318 nutans, L.—10.
Molinia.
1319 cærulea, Mœnch.—18.
Catabrosa.
1320 aquatica, Presl.—17.
Glyceria.
1321 aquatica, Sm.—14.
1322 fluitans, Br.—18.
1322*plicata, Fries.—12.
b. pedicillata, Towns.
1323 maritima, M. et K —16.
1324 distans, Wahl.—13.
1324*Borreri, E. B. S.—3.
1325 procumbens, Sm.—9.
1326 rigida, Sm.—14.
1327 loliacea.—12.
(Triticum, Sm.)
Poa.
1328 annua, L.—18.
1329 bulbosa, L.—3.
1330 alpina, L.—6.
1330*laxa, Hænke.—2.
b. minor, Gaud.
1331 pratensis, L.—18.
c. subcærulea, Sm.
1332 trivialis, L.—18.
1333 compressa, L.—15.
b. polynoda, Parn.
1334 nemoralis, L.—16.
b. montana, Parn.
c. Parnellii, Bab.
1334*cæsia, Sm.—5.
b. glauca, Sm.—4.
c. Balfourii, Parn.—5.
Briza.
1335 media, L.—18.
1336 minor, L.—2.
Cynosurus.
1337 cristatus, L.—18.
1338 echinatus, L.—C.
Dactylis.
1339 glomerata, L.—18.
Festuca.
1340 uniglumis, Sol.—7.
1341 bromoides, L.—17.
b. pseudo-myurus.—9.
1342 ovina, L.—18.
b. vivipara, Sm.
c. tenuifolia, Sibth.
1343 duriuscula, L.—18.
1344 rubra, L.—18 ?
1345 sylvatica, Vill.—7.
1346 arundinacea, Schreb.—4.
1346*"elatior," (*sp. dub.*)—16.
1347 pratensis, Huds.—18.
b. loliacea, Huds.—15.
Bromus.
1348 giganteus, L.—16.
1349 asper, L.—16.
1350 sterilis, L.—16.
1351 madritensis, L.—5.
1352 maximus, Desf.—C.
1353 erectus, Huds.—10.
1354 secalinus, L.—17.
b. velutinus, Sm.
1355 commutatus, Schd.—16.
1356 mollis, L.—18.
b. racemosus, L ?
Brachypodium.
1357 sylvaticum, Beauv.—18.
1358 pinnatum, Beauv.—7.
Triticum.
1359 caninum, Huds.—16.
b. biflorum, Mitten.—1.
1360 repens, L.—18.
b. littorale, Host.
1361 laxum, Fries.—?
1362 junceum, L.—18 ?
Lolium.
1363 perenne, L.—18.
1363**italicum*, Braun.
1364 temulentum, L.—16.
b. arvense, With.
Elymus.
1365 arenarius, L.—15.
Hordeum.
1366 sylvaticum, Huds.—9.
1367 pratense, Huds.—12.

1369 maritimum, With.—10.

Nardus.

1370 stricta, L.—18.

Lepturus.

1371 filiformis, Trin.—13.

LXXXVII. FILICES.

Ceterach.

1372 officinarum, Willd.—15.

Gymnogramma.

1372*leptophylla, Desv.—C.

Woodsia.

1373 ilvensis, Br.—5.

1373*hyperborea, Br.—2.

Polypodium.

1374 vulgare, L.—18.
b. cambricum, L.

1375 Phegopteris, L.—16.

1376 Dryopteris, L.—14.

1377 calcareum, Sm.—11.

Allosorus.

1378 crispus, Bernh.—15.

Cystopteris.

1379 fragilis, Bernh.—18.
b. dentata, Hook.
c. Dickieana, "Sim."—1.

1380 *alpina*, Desv.

1381 montana, Link.—1.

Polystichum.

1382 Lonchitis, Roth.—7.

1383 aculeatum, Roth.—16.
b. lobatum, Sw.—17.
c. lonchitidioides.

1384 angulare, Newm.—12.

Lastrea.

1385 Thelypteris, Presl.—13.

1386 Oreopteris, Presl.—18.

1387 Filix-mas, Presl.—18.

1388 rigida, Presl.—3.

1389 cristata, Presl.—3.
b. uliginosa, Newm.

1390 spinulosa, Presl.—11.

1391 dilatata, Presl.—18.
b. glandulosa, Newm.

1392 fœnisecii, Wats.—10.

Athyrium.

1393 Filix-fœmina, Rh.—18.
b. rhæticum, Roth.—?
c. molle, Hoffm.—?
d. latifolium (Bab.)

Pseudathyrium.

1394 alpestre, Newm.—3.
b. flexile, Newm.—1.

Asplenium.

1395 viride, Huds.—12.

1396 Trichomanes, L.—18.
b. anceps, Lowe?—I.

1397 marinum, L.—14.

1398 lanceolatum, Huds.—6.

1399 Adiantum-nigrum.—18.
b. acutum, Bory.—I.

1400 Ruta-muraria, L.—18.

1400*germanicum, Weiss.—4.

1401 septentrionale, Hull.—6.

Scolopendrium.

1402 vulgare, Sym.—18.

Blechnum.

1403 boreale, Sw.—18.

Pteris.

1404 aquilina, L.—18.

Adiantum.

1405 Capillus Veneris, L.—3.

Trichomanes.

1406 radicans, Sw.—I.

Hymenophyllum.

1407 Tunbrigense, Sm.—9.

1408 Wilsoni, Hook, 13.

Osmunda.

1409 regalis, L.—17.

Botrychium.

1410 Lunaria, Sw.—18.

Ophioglossum.

1411 vulgatum, L.—16.

1411*lusitanicum, L.—C.

LXXXVIII. LYCOPODIACEÆ.

Lycopodium.

1412 clavatum, L.—18.

1413 annotinum, L.—9.

1414 inundatum, L.—12.

1415 alpinum, L.—14.

1416 Selago, L.—18.

1417 selaginoides, L.—12.

Isoetes.

1418 lacustris, L.—7.

LXXXIX. MARSILEACEÆ.

Pilularia.

1419 globulifera, L.—16.

XC. EQUISETACEÆ.

Equisetum.

1420 Telmateia, Ehrh.—16.

1421 umbrosum, Willd.—7.

1422 arvense, L.—18.

1423 sylvaticum, L.—18.

1424 palustre, L.—18.

1425 limosum, L.—18.
b fluviatile, Newm.
c. fluviatile, Fries.

1426 hyemale, L.—14.

1427 trachyodon "A. Br."—1.
b. Morei, Newm.—I.

1428 variegatum, Schl.—9.
b. Wilsoni.

XCI. CHARACEÆ.

Chara.

1429. flexilis, L.

1430 syncarpa, Thuil.

1431 translucens, Pers.

1432 mucronata, A. Br.

1433 gracilis, Sm.

1434 tenuissima, Desv.

1435 Smithii, Bab.

1436 prolifera, A Br.

1437 Borreri, Bab.

1438 polysperma, A. Br.

1439 crinita, Wallr.

1440 vulgaris, Aut.

1441 hispida, L.

1442 tomentosa, L.

1443 aspera, W.

1444 fragilis, Desv.

---

* NOTE TO PAGE SECOND OF COVER.

In the three published volumes of the "Cybele Britannica," as already stated, each species is traced through the 18 subdivisions of Britain only. In the concluding volume of that work, yet unpublished, the species will be arranged in a list according to their comparative prevalence, the census being there carried into the 112 divisions shown on the map in volume third. This will be a real census of species, widely unlike the abortive efforts towards distinguishing between rare and common plants, lately made in the "Phytologist" by writers not sufficiently competent to the matter.—(H. C. W.)

EXCLUDED SPECIES.

A. OCCASIONALLY FOUND WILD THROUGH CULTIVATION, ON BALLAST, &c.

onia corallina, Retz.
idium sativum, L.
setia incana, Br.
nelina dentata, Pers.
lcomia maritima, Br.
simum orientale, Br.
eda Phyteuma, L.
onaria vaccaria, L.
ne Armeria, L.
ubulus baccifer, L.
lva verticillata, L.
ranium nodosum, L.
—— angulatum, Curt.
—— striatum, L.
pericum hircinum, L.
phylea pinnata, L.
onilla varia, L.
lilotus parviflora, Lam.
folium resupinatum, L.
—— tomentosum, L.
—— incarnatum, L.
—— elegans, L.
hyrus latifolius, L.
sa Dicksonii, Lindl.
—— cinnamomea, L.
—— lucida, Ehrh.
rus domestica, Sm.
ytonia perfoliata, Don.
lum stellatum, L.
changelica officinalis, Hoffm.
perula arvensis, L.
—— taurina, L.
ntranthus Calcitrapa, Dufr.

Dipsacus Fullonum, L.
Prenanthes purpurea, L.
Hieracium amplexicaule, L.
Carduus oleraceus, Pers.
Carlina racemosa, L.
Centaurea montana, L.
——— paniculata, L.
Calendula arvensis, L.
Petasites albus, Gærtn.
Nardosmia fragrans, Reich.
Anacyclus radiatus, Lois.
Anthemis tinctoria, L.
Achillea decolorans, Schrad.
——— tomentosa, L.
Xanthium Strumarium, L.
Cuscuta hassiaca, Pfeif.
Datura Stramonium, L.
Physalis Alkekengi, L.
Lycium barbarum, Mill.
Veronica peregrina, L.
Linaria purpurea, L.
——— supina, Desf.
Acanthus mollis, L.
Echinospermum Lappula, Lehm.
——— deflexum, Lehm.
Symphytum asperrimum, Bieb.
——— orientale. L.
Cynoglossum omphalodes, L.
Pulmonaria Virginica, L.
Lysimachia punctata, L.
——— ciliata, L.
Amaranthus retroflexus, L.
Atriplex nitens, Reb.

Atriplex hortensis, L.
Polygonum Fagopyrum, L.
Rumex scutatus, L.
Euphorbia dulcis, L.
——— salicifolia, Host.
Cannabis sativa, L.
Castanea vulgaris, Lam.
Iris tuberosa, L.
——— xiphioides, Ehrh.
——— xiphium. L.
——— pumila, L.
——— germanica, L.
Crocus aureus, L.
——— biflorus, Willd.
Narcissus conspicuus, Don.
——— moschatus, L.
——— incomparabilis, Curt.
——— minor, L.
——— lobularis, Haw.
Lilium pyrenaicum, Gou.
Allium ambiguum, Sm.
Luzula nivea, L.
Setaria glauca, P. B.
Digitaria sanguinalis, Scop.
Phalaris paradoxa, L.
Bromus arvensis, L.
——— patulus, M. K.
——— squarrosus, L.
——— rigidus, L.
——— tectorum, L.
Lolium linicola, Sond.
Athyrium fontanum, Br.
Onoclea sensibilis.

B. NOT DISTINCTLY ASCERTAINED IN BRITAIN, OR AMBIGUOUS PLANTS OTHERWISE.

alictrum calcareum, Jord.
—— nutans, Desf.
—— majus, Jacq.
ola epipsila, Ledeb.
lene annulata, Thore.
gina nivalis, Fries.
alba borealis, Lilj.
ypericum anglicum, Bert.
tentilla mixta, Nolte.

Achemilla conjuncta, Bab.
Saxifraga Andrewsii, Harvey.
——— pygmæa, How.
Hieracium dovrense, Fries.
——— oreades, Fries.
——— saxifragum, Fries.
——— villosum, L.
——— virescens, Sond.
Achillea tanacetifolia, All.

Anthemis anglica, Spr.
Verbascum thapsiforme, Schrad.
——— phlomoides, L.
——— phœniceum, L.
Origanum virens, Link.
Plantago argentea, Lam.
Atriplex glabriuscula, Edmonst.
Rumex conspersus, Hartm
Thesium intermedium, Schrad

Thesium humile, Vahl.
Ulmus carpinifolia, Lind.
——— stricta, Lindl.
Salix dasyclados, Wimm.
——— grandifolia, Ser.
——— hastata, L.
——— holosericea, Willd.
——— petiolaris, Sm.
——— plicata, Fries.
——— pontederana, Willd.
Salix retusa, L.
——— rosmarinifolia, L.
——— serpyllifolia, Scop.
——— viridis, Fries.
Gymnadenia odoratissima, Reich.
Potamogeton "sparganiifolius."
——— "longifolius."
Eriophorum alpinum, L.
Carex brizoides, L.
——— cæspitosa, L.
Carex Mœnchiana, Wend.
——— Gibsoni, Bab.
——— Micheleana, Sm.
——— stictocarpa, Sm.
——— tenella, Sm.
Avena subspicata, Link.
Ægilops ovata, L.
Lepturus incurvatus, Trin.
Botrychium rutaceum, Sw.
Equisetum ramosum, Schukr.

C. ERRONEOUSLY RECORDED, OR SUBSEQUENTLY EXTINCT IN BRITAIN.

Ranunculus alpestris, L
——— gramineus, L.
Thalictrum majus, Jacq
Epimedium alpinum, L.
Papaver nudicaule, L.
Glaucium phœniceum, Crantz.
Vella annua, L.
Clypeola Jonthlaspi, L.
Cardamine bellidifolia, L.
Erysimum virgatum, Roth.
Helianthemum ledifolium, Willd.
Viola stricta, Hornem.
Frankenia pulverulenta, L.
Silene alpestris, Jacq.
Spergula pentandra, L.
Arenaria fastigiata, Sm.
Stellaria scapigera, Willd.
Bufonia tenuifolia, L.
Hypericum barbatum, Jacq.
——— grandifolium, Chois.
Medicago muricata, All.
Vicia hybrida, L.
——— lævigata, Sm.
Rubus arcticus, L.
Potentilla alba, L.
——— opaca, L.
——— tridentata, Sol.
Sanguisorba media, L.
Epilobium Lamyi, Schultz.
Herniaria hirsuta, L.
Cotyledon lutea, Huds.
Saxifraga muscoides, Wulf.
——— pedatifida, Ehrh.
——— leucanthemifolia, Lap.
——— rotundifolia, L.
——— cotyledon, L.
Tordylium officinale, L.
Echinophora spinosa, L.
Chærophyllum aureum, L.
——— aromaticum, L.
Galium saccharatum, All.
——— spurium L.
Fedia eriocarpa, R. & S.
Crepis pulchra, L.
Hieracium Auricula, L.
——— dubium, L.
——— Schmidtii, Tausch.
——— cerinthoides, L.
Centaurea Jacea, L.
——— intybacea, L.
Artemisia cærulescens, L.
Homogyne alpina, Cass.
Erigeron uniflorus, L.
Erica multiflora, L.
Ledum palustre, L.
Vaccinium macrocarpum, Ait.
Gentiana acaulis, L.
Swertia perennis, L.
Cuscuta approximata, Bab.
Hyoscyamus albus, L.
Linaria spartea, Hoffm.
Veronica fruticulosa, L.
Origanum Onites, L.
Teucrium regium, Schreb.
Ajuga alpina, L.
Stachys annua, L.
Echium italicum, L.
Pinguicula longicaulis, "Gay."
Plantago Psyllium. L.
Euphorbia Characias, L.
Crocus sativus, L.
——— minimus, Red.
Scilla bifolia, L.
Arum italicum, Mill.
Typha minor,
Juncus tenuis, Willd.
Eriophorum capitatum, Host.
Carex Davalliana, Sm
——— ustulata. Wahl.
——— hordeiformis, Wahl.
——— argyroglochin, Hornem.
Stipa pennata, L.
Phleum Michelii, All.
Avena planiculmis, Schrad.
Festuca Myurus, L.
Triticum cristatum, Schreb.
Elymus geniculatus, Curt.

Printed by Spottiswoode and Co., New-street Square, London.

G. B. Longstaff,

DESCRIPTIVE BOTANY:

OR,

THE ART OF DESCRIBING PLANTS CORRECTLY IN SCIENTIFIC LANGUAGE.

FOR SELF-INSTRUCTION, AND THE USE OF SCHOOLS.

BY PROFESSOR LINDLEY, F.R.S.

SECOND EDITION.

LONDON:
BRADBURY AND EVANS, 11, BOUVERIE STREET.
1860.

Price One Shilling.

TYRO,

Partes plantæ omnes sibi reddat notissimas.
Vulgatissimas plantas a facie Herbationibus discat dignoscere.
Colligat, Exsiccet, Adglutinet ipse plantas majores, quotquot poterit.
Fructificationis partes primarias discat distinguere.
Classes & Ordines systematis sibi reddat familiares, & simpliciores evidentioresque flores ad eosdem reducat.
Demonstrationibus in Horto frequenter adsit.
Terminos artis secundum definitiones sibi habeat perspectos.

Genera sibi nota, circiter 50, secundum Genera plantarum examinet, collatis fructificationibus cum charactere.
Characteres Genericos 50, proprio marte, eadem methodo conficiat & secundum Genera plantarum emendet.
Descriptiones specierum, 60 circiter, conficiat ex lege artis, incipiendo a simplicissimis plantis, procedendo ad difficiliores, quas corrigat Professor.

Ignotas sibi plantarum species *investiget* ipse, secundum Classes, Characteres, Differentiasque systematis.
Principia & Fundamentum Botanices rite intelligat.
Historiam literariam Botanices sibi familiarem reddat, & imprimis Auctores de Speciebus plantarum consulendos.
Synonyma Auctorum, retrogrediendo ad inventores, evolvere adsuescat.
Usum plantarum speciebus adscribat, Medicum & Oeconomicum.

Linn. Philosophia Botanica.

PRELIMINARY REMARKS.

THE Examiners in Botany in the Universities of Cambridge and London, as well as at Addiscombe and elsewhere, have decided upon making Botanical descriptions a principal feature in their examination papers. To this they have doubtless been led by the difficulty, in the absence of some such exact method, of determining the comparative merits of the students who come before them. Descriptions in natural history not only demand a precision which cannot be equally well secured by any other line of examination, but being formed upon a uniform plan they can be easily and accurately contrasted the one with the other. They moreover offer examiners the means of testing the habits of observation, and the amount of knowledge gained by private study independently of any teacher. And what is most especially important, they render the practice of what is called "cramming" or "grinding" for examination impossible.

But the test in question, excellent as it is, proves extremely embarrassing to students, owing to the absence of sufficient information in recent elementary works as to the manner in which Botanical descriptions are to be prepared. In the author's "Introduction to Botany," editions 1, 2, and 3, and in the article Botany of the publications by the Society of Useful Knowledge, the subject was discussed, and it forms part of a short chapter in Professor Henfrey's *Elementary Course*, but the former of these works have long been out of print, and if procurable would hardly prove sufficiently explanatory to mere beginners. It therefore seems desirable that the art, for it is an art, of drawing up descriptions of plants in correct Botanical language, should be rendered so familiar that all who have mastered the rudiments of Botany and learned the meaning of common technical substantive names, may understand it. Most especially is it required for the sake of those who, under recent academical regulations, are admitted to examination without having been prepared in College or any great recognised school. Gentlemen who mainly rely upon self-instruction cannot dispense with a guide to such technical subjects as descriptive Botany.

In preparing the following instructions the excellent maxims of Linnæus, the father of good technical botany, and one of the most skilful describers that ever lived, have been introduced in their original Latin, by way of illustration. Those who are unacquainted with that language will, nevertheless, find the English text sufficient for their purpose.

Students are, however, strongly advised to accustom themselves to describing plants in Latin, which is much better suited for the purpose than English. They will find in the following pages good models for their imitation.

Those who are anxious to make themselves practically acquainted with Botany should exercise themselves diligently in this subject, for which the commonest weeds are as well suited as the rarest species. He who can describe readily, fully, and correctly an Aconite, an Almond-tree, a Dead nettle, Groundsel, Chickweed, a Stinging-nettle, a Snowdrop, a Crocus, an Ornithogalum, the Flowering rush, a Carex, any common Grass, Wheat, Barley, Oats, or Rye, can have no difficulty in facing the most severe examiner.

Whether a description is well drawn up may be tested by considering whether a person who had never seen the plant could make a drawing of it from the description. For DESCRIPTIONS ARE MERELY PICTURES IN WORDS.

An example of this will be found in the following account of a Convolvulus by the Rev. R. T. Lowe.

Convolvulus caput-Medusæ.

C. dumosus humilis nanus pulvinato-cæspitosus ramosissimus durissimus spinosus cinereus; ramulis abbreviatis lignosis densissime glomerato-intertextis, novellis strictis rigidis acutis spinescentibus; foliis parvis lineari-oblongis v. anguste spathulatis obtusis crassiusculis sericeo-cinereis; floribus axillaribus solitariis breviter pedicellatis parvis extus sericeis, antheris (purpureo-lilacinis) in fauce apparentibus subexsertis; stylis 2 distinctis filiformibus antheras paulo excedentibus.

A most remarkable and (for its genus) paradoxical species, so excessively dwarfed down and stunted that it has more the appearance, when growing, of a rounded convex stone, covered with a grey Lichen, or of some Madreporiform mass, such as the Brain-coral (*Meandrina*, Lamk.), than of a phænogamous plant; though, when torn up by the root, it presents rather the form and aspect of some enormous grey fungus (*Boletus*), being a stipitate, pulvinate, often hemispherical or turbinate, hard, woody, spinous mass of densely interwoven, rigid branches, with quite small and inconspicuous leaves and flowers in proportion to its size, like some closely-browsed or clipped-down thorny bush, and of the shape exactly of a miniature Stone-Pine (*Pinus Pinea*, L.). Root woody, very hard and stiff, nearly or quite simple and tap-shaped, covered with a rugged, longitudinally-striated, brown bark, and from the thickness of the little finger to that of the thumb at the crown, where it immediately divides into a dense mass of very short, stiff, woody, closely interlacing and entangled branches, forming a very hard, rigid, spinous, cushion-like, grey, flattened head, convex in the centre, from 3 or 4 to 18 inches in diameter, and from 1 to 6 inches thick in the middle; so hard, compact, and woody, that it will often bear the weight of a man standing or even stamping on it, without yielding or sensible disfigurement. Young shoots originating chiefly from within or beneath the roof-like cushion or *pileus* formed by the older, outwardly-knobbed, spurred and stunted, interlacing branches; straight, hard, stiff, rigid, spine-like, seldom more than 1 or 2 inches long, round, terete, sharp, and hard-pointed, finely and evenly striate longitudinally, very finely and minutely cinereo-puberulous. Leaves 2 to 5 or 6 lines long, and ½ – 1 line broad, thickish in substance, subconduplicate, clothed with adpressed silky-grey hairs, linear-oblong, subspathulate, obtuse. Flowers pretty, but small and rather inconspicuous, solitary, axillary, subsessile in the axils of the leaves on the young shoots, light rose-pink or purple, much resembling those of *C. arvensis*, L., but very much smaller, being only 4 or 5 lines in diameter. Calyx bracteolate; sepals and the adpressed bractlets oblong, short, one-third or one-fourth the length of the corolla, silky grey. Corolla 5 or 6 lines in diameter, three or four times the length of the bracts and sepals, funnel-shaped, 5-angular, and outwardly silky-pubescent in five longitudinal rays or narrow acuminate stripes.

The method here adopted of bringing the features of the plant before the mind's eye is very perfect. No one knowing how to draw can have a difficulty in representing the essential features of this Convolvulus, guided by the technical language alone of the describer.

It may be taken for certain that a description which will not accomplish the same end is bad.

CHAPTER I.

IMPORTANCE OF CORRECT DESCRIPTION.

"Descriptio est totius plantæ character naturalis, qui describat omnes ejusdem partes externas."—*Linn. Phil. Bot.*

Many persons have experienced the inconvenience of not being able to describe correctly the curious or useful plants they have occasionally met with. More especially travellers, in attempting to communicate to others what they have seen, are accustomed, if unacquainted with natural history, either to mention the vulgar names they have heard applied to plants, or to describe them in what is called a popular manner. The vulgar names of plants rarely convey useful information, because they are very frequently used without any precision; for example, in this country, the word Laurel is applied to four different plants: the Common Laurel and the Portugal Laurel are both Cherries; the Spurge Laurel is a Daphne; the Alexandrian Laurel is a Ruscus; while the only true Laurel, commonly met with in England, is called the Sweet Bay tree. "Popular" descriptions, like the drawings of plants made by persons who are not botanists, are more calculated to mislead than inform. They either convey a false idea of what they profess to explain, or no idea at all.

Let us suppose a plant to be described in the following words:—"The leaves are about 4 inches long, narrow, dark green, smooth on the surface, plain at the edge. The flowers grow in tufts, about 10 together, and are straw-coloured; they are small, downy, and contain 6 stamens each. The germen stands up in 3 brownish segments resembling a cup. The trees are 50 to 60 feet high, evergreen, with large horizontal branches almost as low as the earth." If the reader attempts to ascertain what kind of tree this may be, he cannot possibly succeed, for the description will apply to many kinds of plants of the most dissimilar nature. The description is useless, because the author has only mentioned peculiarities common to many trees, and has omitted all that are peculiar to a few. Had he said that the tree was "evergreen, with ribbed leaves, apetalous flowers, and 6 stamens having recurved anther-valves," thus using the technical and precise language of science, instead of the vague and uninstructive phraseology of mere conversation, he would have conveyed a distinct idea to the mind of the reader, at the expense of only about a dozen words instead of sixty-eight; or he could have combined the two, which, for the purposes of narrative, might have been better.

Linnæus gives some examples of this kind, which, as well as the precepts that introduce them, the student will do well to consider.

Descriptio justo longior aut brevior utraque mala est.

Longa nimis evadit descriptio cum color viridis in Herba, mensura partium et similia, facillimè variantia, diffusa oratione proponuntur.

Breviores justo evadunt descriptiones cum excluduntur notæ singulares, et partes essentiales Herbæ, licet minimæ, uti Stipulæ, Bracteæ, Glandulæ, Pili, et similia.

By way of further illustration, he quotes three descriptions of *Linum usitatissimum*, the common Flax plant, viz.:

A. The very short and imperfect one of Dodonæus.

Radices *exiles*. Culmi *seu virgæ tenues, rotundæ*. Folia *oblonga, angusta, acuminata*. Flores *in summis virgis, speciosi, cærulei*. Vascula *parva, rotunda, orbiculata*. Semen *aliquatenus oblongum, læve, glabrum, splendens, ex fulvo punicans.*

B. A very long, superfluous, and empty one.

Radices *angustæ, subdivisæ, intra terram reconditæ.*

Caules *erecti, rotundi, virides bipedales vel tripedales, ramosi:* Ramis *caule dimidio brevioribus.*

Folia *angusta, viridia, acuta, plurima, uncialia ad angulum acutum a caule discedentia, basi affixa, non tomentosa, aut villosa; superiora folia tantum semiuncialia sunt et quatuor lineas* *lata; inferiora tres lineas lata, at suprema vix duas lineas adtingunt in latitudine.* Pedunculi *simplices, unciales vel sesquiunciales, crassitie vix dimidiæ lineæ.* Flores in *summitatibus ramorum, ampli, patentes,* &c.

C. With these he contrasts a natural and regular description, as he draws it up himself.

Radix *simplex, perpendicularis, flexuosa, pallida:* radiculis *lateralibus capillaribus.*
Caulis *simplex, perpendicularis, teres, filiformis.*
Folia *alterna, sessilia, lanceolata, obsolete trinervia, acuminata, erectiuscula, utrinque glabra: subaxillaria paulo majora.*
Rami *ex axillis foliorum summorum, erecti, foliis minoribus instructi;* rudimenta *ramorum marcescentia ex axillis foliorum inferiorum.*
Pedunculi *foliis oppositi, eisque longiores, filiformes, nudi, terminati* Fructificatione *solitaria, in generibus descripta.*
Cotyledones *quasi quatuor, cruciatim oppositi, quorum duo inferiores subovati, superioribus duplo latiores.*—Linn. Phil. Bot., § 330.

The student should compare these descriptions carefully with the *Linum* itself.

If such descriptions as have just been criticised are scientifically useless, much worse are those which proceed from professed botanists, in whose supposed knowledge and technical skill confidence is naturally reposed. In the works of some of the successors of Linnæus himself, the descriptions are so meagre and inaccurate, that they were mere botanical enigmas till the meaning of their authors was determined by other evidence than what the descriptions afford. Thus, Thunberg gives the following description of the fructification of a genus he calls Nigrina:—

"*Calyx* none, except a one-leaved bract. *Corolla* of four petals. *Filaments* four, very short. *Anthers* globose, white. *Germen* (ovary) superior; *style* single; *stigma* . . . . . *Fruit* unknown, perhaps a capsule."

Here, in the first place, several most essential points are neglected, such as the insertion of the stamens, the dehiscence of the anthers, the relation of the stamens to the petals, the internal structure of the ovary, the number and position of the ovules,—all ascertainable without difficulty, and the more indispensable because of the absence of fruit. Then, irrelevant matter is introduced, such as the length of the filaments and colour of the anthers. And, finally, which is worse than all, the description is false; for the flowers have neither calyx nor corolla; the filaments are three, not four; and the anthers are not globose, but irregular, ovate, compressed, fleshy bodies.

But it is not in negligent observation alone, or in the misplacing the members of a sentence, that an essential character may be defective: it may be expressed with a certain kind of exactness, and a due attention to arrangement, yet words may be wrongly employed, or important characters may be omitted, or the author may not understand the structure of what he is describing. As an instance of this, the following description of the genus CAREX, by a botanist of eminence in his day, may be usefully studied:—

"*Barren flowers* numerous, aggregate, in one or more oblong dense catkins; their *scales* imbricated every way. *Calyx* a single, lanceolate, undivided, permanent *scale* to each floret. *Corolla* none. *Filaments* 3, rarely fewer, capillary, erect or drooping, longer than the scales. *Anthers* vertical, long, linear, of 2 cells.

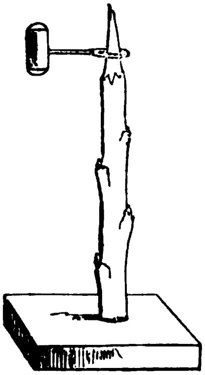
"*Fertile flowers* numerous, in the same, or, more usually, in a different catkin, very rarely on a separate plant. *Calyx* as in the barren flower. *Corolla* a single, hollow, compressed, ribbed, often angular, permanent glume to each floret; contracted, mostly cloven, and often elongated at the extremity. *Germen* superior, roundish, with three, rarely but two, angles, very smooth. *Style* one, terminal, cylindrical, short. *Stigmas* three, more rarely two only, awl-shaped, long, tapering, downy, deciduous. *Seed* the shape of the germen, with unequal angles, loosely coated with the enlarged (either hardened or membranous) permanent corolla, both together constituting the fruit."

This character is carefully written, but full of inaccurate and confused applications of terms. The word "catkin" should be "spike;" for a catkin is deciduous, a spike persistent, and the inflorescence in Carex is of the latter kind. In the next place, what is called the "calyx" is a bract. What is called the "corolla" of the fertile flowers consists of two confluent bracts, and is, therefore, not a single "glume," but a double one. Finally, what is called the "seed," is the pericarp; in the young state it is called the germen, which is equivalent to ovary, but by the time the ovary is ripe, it is metamorphosed into a seed!

Inaccuracies of this kind not only disfigure botanical writings, but very often lead the inexperienced botanist into errors and misconceptions, and are to be most carefully avoided.

CHAPTER II.

HOW TO EXAMINE AND OBSERVE.



In preparing to describe a plant the first thing is to provide the means of observation. These consist of a sharp pen-knife and a pocket lens, or, if means permit it, of a simple dissecting microscope. The pocket lens should not have a longer focal distance than an inch and half; the microscope should be supplied with a 2 inch, ½ inch, and ¼ inch lens. If a microscope is unattainable, then what is called a "Coddington" may be employed for minute objects. But as neither a pocket lens nor a Coddington have a Stand, and as it is continually necessary for the observer to have the free command of both hands, some cheap contrivance should be provided for carrying such instruments. Travelling botanists have used a short stick, pushed into a lump of clay, the hole in the case of the lens, or the loop of the Coddington slipping over it, as in the annexed cut, or a block of wood is used. The object to be attained being merely to fix the lens steadily while the fingers are employed in dissecting below it, the mode of securing that end is unimportant.

Apparatus having been provided, the student should select for examination as perfect a specimen as he can obtain; and should carefully study every part in the order hereafter explained. In doing this he *must on no account guess*, but be *certain* that he sees correctly what is before him. This is not difficult in the case of roots, stems, leaves, and their parts; but the flower, from its general smallness, and somewhat complicated structure, demands a little skill in dissection, which is only to be gained by experience.

After its external structure has been determined, it is necessary to open the flower. Mere looking down into its tube or interior leads to nothing but error. The student should hold it in his left hand and split it *longitudinally* by a rapid cut *from below upwards*. This lays bare the whole of the interior, shows the number and position of the parts, and their insertion, which is very important. If he attempts to divide a flower by cutting it *from above downwards* he only crushes and disfigures his specimen. In the case of the ovary it is usually necessary to ascertain its placentation, which, if it is not seen in the first longitudinal section, can be best determined by making a *transverse* section.

When, as in Umbelliferous plants, the position and number of interior longitudinal passages or of superficial lines and plates demand attention, a thin horizontal slice, placed in water, and viewed by transmitted light, will give the information required.

In examining seeds of any kind, where dissection is required, cut into them perpendicularly, beginning at the hilum and passing the knife through the axis; in this way the embryo and its relation to other parts usually becomes distinctly visible. Failing this the observer must have recourse to crushing, or careful skinning and unrolling.

Seeds of small size are frequently so hard and slippery that they cannot be kept steady even in water. In such case, a little stiff gum, or varnish of shell-lac, may be smeared on a slip of glass in the field of the microscope, and the seeds placed upon it. As soon as the varnish is hard and dry, they can be sliced readily with a sharp knife.

When minute parts are so opaque as not to be readily examined, the use of oil of turpentine instead of water, as the medium in which they are placed for observation, is useful.

When parts are shrivelled or dried up, as is always the case in herbaria, they must be relaxed by immersion in boiling water.

In all cases where dried flowers are to be dissected, the air should be driven out by boiling for a short time before any attempt is made to separate their parts.

CHAPTER III.

GENERAL RULES TO BE OBSERVED.

> "Descriptio compendiosissimè, tamen perfectè, terminis tantum artis, si sufficientes sint, partes depingat secundum *Numerum*, *Figuram*, *Proportionem*, *Situm*."—*Linn. Phil. Bot.*

In drawing up a description care must be taken that every term is used in its exact sense; that all is perspicuous and free from ambiguity, and that nothing superfluous is introduced. In the following description of *Viola tricolor*, the wild Pansy, a very large quantity of superfluous words occurs, although the terms are employed correctly.

The root of this plant consists of a great number of unequal irregular fibres. The stems first fall prostrate, and then rise up, and are perfectly smooth all over the surface; their form is square, their interior is hollow, and at every place where the leaves are set on, they are a little tumid. The leaves grow upon opposite sides of the stem at tolerably equal distances one above the other; they have a form between ovate and oblong, have a distinct leaf-stalk, and are coarsely cut at their edges in a serrated manner; they are quite destitute of hairiness, and are longer than the stipules which grow at their base. The stipules in colour and texture resemble the leaves; they are cut almost to the middle into a number of narrow lobes, of which the terminal one is much the largest; at the base they are prolonged more on one side than another, in a hastate manner. The beautiful little flowers grow singly from the stem, at the places where it joins the leaves, and they have a nodding position on their peduncle; the latter has a smooth surface, is distinctly angular, curves inwards at the upper end, and has a twist somewhere near its middle. At the upper end of the peduncle grow two small bractlets, resembling fine scales, prolonged at the base into something of a hastate figure. The calyx of this plant consists of five distinct sepals, having the same colour and texture as the leaves; they are of a narrow ovate form, sharp-pointed, quite free from hairs, not in any way lobed or divided, and extended below the point of origin into a flat rounded appendage, which is divided by small toothings at the edge: of the sepals, those which stand next the front of the flower are much the largest. The corolla consists of five petals, which are of unequal size, oblong, with a little stalk at the base, and rounded at the upper end; the two uppermost are larger than the rest, of one uniform purple colour, while the three lower are yellow, with purple lines at the base, and furnished with a little tuft of hair at the bottom of the streaks; the intermediate one of these petals is furnished with a short straight spur at the base. The stamens are five in number, inserted into the line between the base of the ovary and the sepals, not so long as the claws of the petals, and of unequal size; the anthers have no filaments, are of a membranous texture, are fringed with white hairs at the edge, and are extended into a broad brown membranous appendage at the point; those two stamens which stand in front of the flower are longer than the others, and project from their base on one side a green slender thread-shaped process, which is introduced into the spur of the front petal of the corolla. The ovary has no adhesion to the sepals, is of a spheroidal form, and contains one single cell; on its inside, the ovules, which are very numerous, grow to three broad lines running from the apex to the base of the cavity at equal distances; the ovary is terminated by a style, smooth, thickest at the upper end, bent like the letter S, and bearing at the point a round hollow stigma, through one side of which there is an opening into the interior. The ovary, when ripe, changes to a seed vessel of a dry, cartilaginous consistence, containing one cell, and dividing into three equal spreading ovate-lanceolate valves, between the broad lines on which the seeds are inserted, so that when the valves are spread open, the seeds are seen sticking to the middle. The seeds are small, shining, oblong bodies, rather narrow at the lower end, and of a pale brown colour; the point of attachment to the placenta is thickened in a fungus-like manner; from this part there rises a fine elevated line, which terminates in a depressed discoloured round spot, stationed at the top of the seed. In the interior is found an embryo of a deep green colour, quite straight, and having a taper radicle, with thin flattened cotyledons a little rounded at the back. Surrounding the embryo is found a quantity of fleshy brittle albumen, in the very axis of which the embryo is placed.

To this there is little other objection than its needless length; it is what Linnæus called "longissima et superflua." But it is obvious that were all plants to be thus described, the 100,000 species supposed to be now known would fill 100,000 pages of ordinary matter and would form a library of themselves; added to which would be the great difficulty of wading through such a marsh of needless words. By adopting the scientific method, more than half the words are saved, and the description itself comes out more clear and comparable. The following shows this:—

Root fibrous.

Stems decumbent, smooth, square, fistular, slightly tumid at the nodes.

Leaves alternate, ovate-oblong, petiolate, coarsely serrated, smooth, longer than the stipules; stipules leafy, pinnatifid, half-hastate: terminal lobe much the largest.

Flowers solitary, axillary, nodding; peduncles smooth, angular, twisted, incurved at apex.

Bractlets two, minute, membranous, sub-hastate near the apex of the peduncle.

Sepals five, herbaceous, linear-ovate, acute, smooth, entire at the base, prolonged into a concave, rounded, toothletted appendage: the anterior much the largest.

Petals five, unequal, oblong, unguiculate, rounded at the apex; the two upper largest, whole coloured, purple; the three lowest yellow with purple streaks, and bearded at base; that in the middle having a short straight spur at the base.

Stamens five, hypogynous, shorter than the ungues, alternate with the petals, unequal; anthers sessile, membranous, ciliated, with a broad brown membrane at apex; the two anterior the largest, spurred; their spurs green, subulate, lying in the spur of the corolla.

Ovary superior, round, one-celled, with three parietal polyspermous placentæ; style smooth, sigmoid, clavate, as long as the ovary; stigma capitate, hollow, with an oblique aperture on one side.

Capsule one-celled, three-valved, with a loculicidal dehiscence; valves ovate-lanceolate, spreading, bearing the seeds in the middle.

Seeds shining, roundish, smooth, pale brown; hilum fungous; raphe elevated; chalaza depressed on the apex.

Embryo straight, green, in the axis of fleshy albumen' radicle terete; cotyledons plano-convex.

Even this may be shortened by omitting all that is common to *Viola tricolor* and other species of the genus Viola; as thus:—

Root fibrous.

Stems decumbent, smooth, square, fistular, slightly tumid at the nodes.

Leaves ovate-oblong, petiolate, coarsely serrated, smooth, longer than the stipules; stipules leafy, pinnatifid, half-hastate: terminal lobe much the largest.

Flowers nodding; peduncles smooth, angular, twisted, incurved at apex.

Bractlets 2, minute, membranous, sub-hastate, near the apex of the peduncle.

Sepals linear-ovate, acute, smooth, entire: appendage concave, rounded, toothletted.

Petals oblong, rounded at the apex, the two upper whole coloured purple, the three lowest yellow, with purple streaks, and bearded at the base.

Anthers ciliated; the spurs green and subulate.

Ovary round; style smooth.

Seeds shining, smooth, pale brown.

In framing descriptions of whatever kind, the order of development must be observed. (*Descriptio ordinem nascendi sequatur. Linn. Phil. Bot.* § 328.)

It is not allowable to take the flower first, then leaves, then root, then fruit, then inflorescence, and so on; but the description, if complete, must begin with the root and end with the seed. Linnæus gives the following example of the manner in which this should be done, in the Lime tree (*Tilia Europæa*).

> Radix: Caudex *descendens, divaricatus, ramosissimus, teres, flexuosus, epidermide decidua:* Radiculis *capillaribus, flexuosis subramosis.*
>
> Caudex adscendens *arboreus, teres, ramosissimus,* cortice *crasso, poroso, tectus* Epidermide *in antiquo striato-rimosa in tenello lævi, glabra,* ramis præcedentis anni instructis gemmis alternis.
>
> Gemmæ *ovatæ, prominentes, constructæ Squamis duabus, alternis, oblongo-ovatis, obtusis, convolutis, subcarnosis, stipulaceis.*
>
> Stipulæ *gemmaceæ, oppositæ, ovatæ. glabræ, integerrimæ, concavæ, involventes folia et caulem.*
>
> Caulis *simplicissimus, teres, subflexuosus a folio ad folium, decumbenti-patens, lævis, adspersus punctis aliquot vagis obsoletis.*
>
> Folia tenella *conduplicata, secunda, rugosa, villosa undique;* adulta *cordata, nervosa, venosa, inæqualiter serrata, acuta, supra glabra, pilis vix conspicuis adspersa, subtus in axillis vasorum majorum barbata.* Petioli *teretiusculi, læves, folio breviores, fere disticha prodeuntes, interjectis spatiis folio brevioribus.*

Pedunculi *solitarii, petiolo laterales, longiores, filiformes, apice trifidi; lateralibus trifidis, extremitatibus unifloris;* Flosculi *ideoque septem, altitudine æquales.*
Bractea *lanceolata, obtusiuscula, albo-colorata, integerrima, longitudine pedunculi, a basi ad medium longitudinis pedunculo unita.*
Floris Perianthium *quinquepartitum, concavum, colorato-flavescens, magnitudine ferme corollæ, deciduum.* Corollæ Petala *quinque, oblonga, obtusa, apice crenata, flavo-albicantia.* Staminum Filamenta *plurima: triginta vel quadraginta, setacea, receptaculo inserta, longitudine corollæ.* Antheræ *subrotundæ.* Pistilli Germen *subglobosum, hirsutum.* Stylus *cylindricus, altitudine staminum.* Stigma *obtusum, pentagonum.* Pericarpium *coriaceum, globosum, quinqueloculare, quinquevalve, basi dehiscens.* Semina *solitaria, subrotunda.*
Cotyledones *quinquefidi, extremis et media longioribus.*

In this description, terms now disused are employed, and things now attended to are neglected; but, upon the whole, it is a good specimen of his manner of description.

Another rule which Linnæus insisted upon, was, that each separate organ should have a paragraph to itself. (*Descriptio distinctas partes plantarum in distinctis paragraphis tradat.*) He required that the parts of a plant should be as clearly distinguished in a description as they are distinct in the plant itself. (*Partes plantarum in descriptione æque distinctæ evadant ac in ipsa planta.*) He also insisted upon such type being employed as would enable the reader not only to find the parts he might be in search of, but also to discover anything that was left out. (*Majusculis literis pingantur omnes partes plantæ, at partium partes minusculis et a vulgaribus diversis. Usus inde resultat quod non modo partes a Lectore facilius reperiantur, sed et quod omissa facilius in descriptione perspiciantur.*) For, he added, nothing is more tiresome than a long description in which the several parts of plants are neither distinguished by paragraphs nor differences of type. The description which Linnæus gave of the Castor-oil plant, *Ricinus communis*, illustrates his meaning:—

Radix *ramosa, fibrosa.*
Caulis *erectus, teres, viridis, articulatus, inanis, lævis: striis sparsis longitudinalibus, superne flexuosus, altus orgyam unam alteramve.*
Rami *solitarii, ex axillis superioribus foliorum, cauli similes, altiores;* ex inferioribus axillis *breviores, vel marcescentes, vel seriores* Rami.
Folia *alterna, peltata, novemlobata: Lobis exterioribus majoribus, magis angulatus: Nervis totidem ab umbilico ad loborum apices excurrentibus; obtusiuscule inæqualiter serrata, reticulato-venosa, utrinque lævia, supra glabra, disco extrorsum versa.*
Hæc *ante explicationem plicata, serraturis glandulosis.*
Petioli *teretes, læves, patentes, sessiles, filiformes, longitudine foliorum.*
  Glandula *supra basin petioli: latere superiori, obtusa, solitaria.*
  Glandulæ *binæ peltatæ, in apice petioli: latere superiori.*
  Glandulæ *duæ oppositæ, ad basin petioli, in caule.*
Stipula *petiolo opposita, membranacea, glabra, solitaria, caulem ambiens ad petiolum usque, concava, acuta, decidua.*
Pedunculus *ramos terminans, e regione petioli inter ramum et stipulam, erectus, nudus, adspersus, Umbellulis alternis, sessilibus.*
  Involucrum *umbellulæ triphyllum, membranaceum, minimum, inæquale, marcescens.*
  Umbellulæ *inferiores multifloræ, masculæ; superiores pauciores, unifloræ, femineæ.*
  Pedicelli *alternatim excrescentes deflorentesque.*
Flores *Masculi pedicellis longioribus insidentes.*
  Masculi. Calycis Perianthium *monophyllum, quinquepartitum: laciniis ovatis, concavis.* Corolla *nulla.* Staminum Filamenta *varia, filiformia, ramosa et subramosa, calyce longiora.* Antheræ *subrotundæ, didymæ.*
  Feminei. Calycis Perianthium *monophyllum, tripartitum, deciduum: laciniis ovatis, concavis.* Corolla *nulla.* Pistilli Germen *ovatum, tectum spinis subulatis inermibus.* Styli *tres, bipartiti, erecto-patentes, subulati, hispidi, purpurascentes.* Stigmata *simplicia.* Capsula *subrotunda trisulca, obsolete triangularis, undique aculeata, trilocularis, trifariam dehiscens, elastica.* Semina *solitaria, subovata, maculis inæqualibus.*

Although these rules are not strictly observed at the present day, and *must* be sometimes neglected, yet the student will find it advantageous to make it a practice to observe them. Italics, however, are needless, and are now scarcely ever thus employed.

In punctuating descriptions, always observe to separate, 1, adjectives relating to the same noun by commas; 2, parts of the same organ by semicolons; 3, distinct organs by a period; thus:

Leaves lanceolate, acuminate, villous; *petiole* short, winged, glandular; *stipules* rudimentary. *Racemes* terminal, nodding, many-flowered, secund.

CHAPTER IV.

OF THE USE OF SUBSTANTIVE TERMS, OR, NOUNS EMPLOYED IN TECHNICAL LANGUAGE.

The first attention of the student will be necessarily directed to the proper application of the Nouns employed in botanical descriptions. Until this is thoroughly understood no precision can be secured. It is owing to their unskilful, or inexact, or negligent application, that the writings of some botanists are so open to criticism.

Thus we find a late popular botanical author committing the errors which were pointed out in page 6, in his description of Carex. The following are other examples. The common Tansy (*Tanacetum vulgare*) is stated to have the "*Germen* (an old word for ovary) obovate, compressed; the *seedvessel* (= pericarp) none but the permanent calyx; the *seed* oblong, angular," so that the ovary becomes a seed, and a calyx becomes a pericarp! Again, in Coltsfoot (*Tussilago Farfara*), "*Common calyx* simple, cylindrical;" by which he meant involucrum. "*Seedvessel* none, except the altered calyx," thus converting bracts into a pericarp. "*Seed* obovate-oblong, compressed," meaning the real pericarp!

The same author's description of *Poa* is an instructive instance of what should be avoided. Firstly, the *Calyx* contains a *spikelet!* by which he meant that the spikelet has at the base a pair of *glumes*. Then he makes the *Corolla* consist of two valves, although the part thus misnamed (the *paleæ*) is external to all the parts of fructification in each floret, and cannot by any possible latitude of language be termed corolla; if objection were taken to the word *paleæ*, then the part should have been called a *calyx*. Finally, the *germen* (*ovary*) becomes a *seed* when ripe!!

A proper selection of substantive terms is therefore indispensable. In describing a Crocus it is not allowable to call its *corm* (a kind of stem), or the prostrate *stem* (*rhizome*) of Acorus, a root. The technical name of the part spoken of must be scrupulously employed.

The meaning and application of such terms are described correctly in all modern elementary works of repute, and require no illustration in this place. Where the student is referred in a succeeding chapter to figures by the letters SB, it is to *School Botany*, in which work the necessary explanation will be found.

CHAPTER V.

OF THE USE OF ADJECTIVE TERMS, OR TERMS EXPRESSING THE QUALITY OF NOUNS.

The great difficulty to encounter in describing plants is to know how to use the terms by which the peculiar quality of their parts is indicated. For this purpose a very great number of words is employed, some in their ordinary sense, some in quite a peculiar manner. To the first belong such terms as *Blue, green*, &c., expressing colour; *round, long, broad*, &c., expressing form; *blunt, sharp, thick, thin*, and so on. To the second may be referred words like *secund, coloured, herbaceous, sinuous, parted, divided, toothed*, which are not used in their ordinary sense.

An enormous number of words of this kind has been invented by botanical writers, as may be seen in Bischoff's valuable Handbuch,* a 4to work of 1609 pages, illustrated by 3911 figures on 79 plates. But of these many relate to Cryptogamic Botany, others to Vegetable Anatomy, some are obsolete, and a very large quantity arise out of attempts at introducing into language refinements that are inapplicable to descriptive Botany, because of the variable or uncertain attributes of the parts to which such words are intended to apply. A considerable number moreover illustrates the meaning of double adjectives, which scarcely require illustration.

---

* *Handbuch der Botanischen Terminologie und Systemkunde*, von Dr. G. W. Bischoff, Nurnberg, 4to.

Double adjectives are those which, formed from two words having different meanings, indicate some quality between the two meanings. Thus, *ovate-lanceolate* means a form intermediate between *ovate* and *lanceolate*; *racemoso-paniculate* indicates an inflorescence consisting of *racemes* arranged in a *paniculate* manner; *sinuate-laciniate* expresses an outline which is *sinuate*, while the lobes are *laciniate*; and so on. A little practice suffices to understand the construction and application of all such words, with which it is needless to burthen elementary works.

Linnæus, whose descriptions are admirable for their time, used very few terms. In his Philosophia Botanica, 107 only are admitted among leaves, the most variable of all the organs of a plant; and even of these some are used in their usual sense, as *sulcate*, *obtuse*, *acute*, &c.

In this little work such terms only are selected as the student really ought to understand, and those alone are illustrated which mere words cannot explain with precision.

CHAPTER VI.

TERMS.

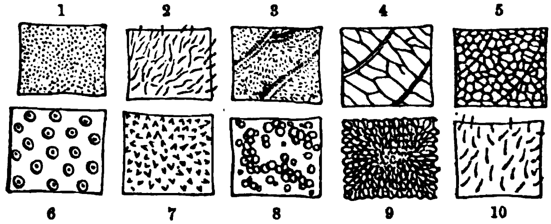
The following terms are such as most commonly occur. The woodcuts sufficiently indicate the meaning of the words with whose numbers they correspond. Other terms are illustrated in School Botany, referred to as SB. When neither figures nor references are given, the words do not seem to require them.

Some terms have a universal, or GENERAL APPLICATION, being employed in the same sense wherever they are used; such are those describing *surface*, *colour*, *relative position*, *margin*, *point*.

Other terms have a particular, or SPECIAL APPLICATION, being employed when speaking of some particular part. It is, however, to be observed, that many of these special terms may be used when speaking of similar though different parts. Thus some words applicable to the forms of leaves equally belong to petals, or to any other flat bodies.

GENERAL TERMS.

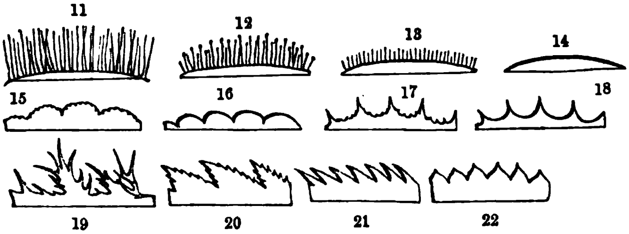
The SURFACE (*Superficies*) is naked (*lævis*); smooth (*glabra*, *polīta*, *lûcida*); silky, 2 (*sericea*); downy, 3 (*pubescens*); hairy (*pilosa*); shaggy (*hirta*, *hirsuta*, *villosa*); furred (*tomentosa*); velvety (*velutina*); woolly (*lanata*); cobwebbed (*arachnoidea*); scurfy (*lepidota*); glandular, 6 (*glandulosa*); dotted, 1 (*punctata*); chaffy (*ramentacea*); rough, 7 (*scabra*, *aspera*); wrinkled, 5 (*rugosa*); netted, 4 (*reticulata*); hispid, 10; warted, 8 (*verrucosa*); papillose, 9.



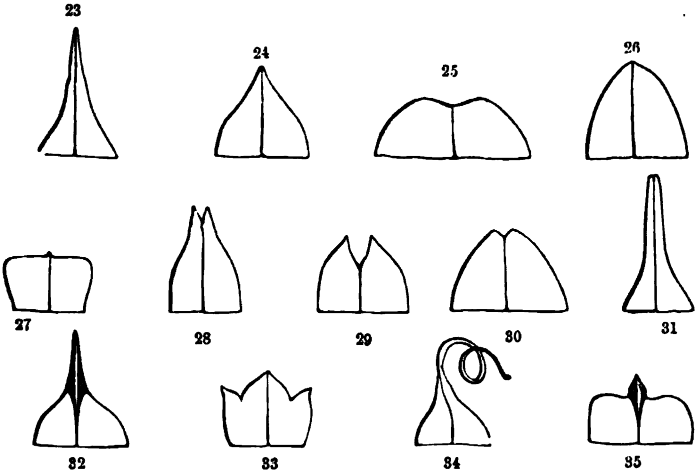
Words expressive of COLOUR are used in their ordinary sense, with the exception of "herbaceous," which always signifies green, and "coloured" (*coloratus*), which includes every colour except green. The Latin word *concolor* is employed when different parts are of the same colour; *discolor* in like manner is used when two contiguous parts are of different colours.

In RELATIVE POSITION, parts are imbricated, or overlap by their edge or points; valvate, when two straight edges fit together without overlapping; plicate, when folded like a lady's fan; convolute, when twisted in one direction; induplicate, when the edges are bent inwards; alternate, opposite; whorled (*verticillatus*), when more than two parts stand on the same level round a common axis; stellate is verticillate, with the parts narrow and sharp pointed; decussate (SB, clxxiv.), when opposite parts cross each other; distichous (SB, ccxliii.), when parts form two opposite perpendicular rows.

The **Margin** (*Margo*), is ciliated, 13 (*ciliatus*); glandular, 12; fringed, 11 (*fimbriatus*); cartilaginous (*cartilagineus*); entire, 14 (*integer*); serrate, 21; doubly serrate, 20 (*duplicato-serratus*); toothed, 18 (*dentatus*); doubly toothed, 17; crenelled, or crenate, 16 (*crenatus*); doubly crenelled, 15; acutely crenelled, 22; wavy (*undulatus*); curled, 95 (*crispus*); spiny, 19.



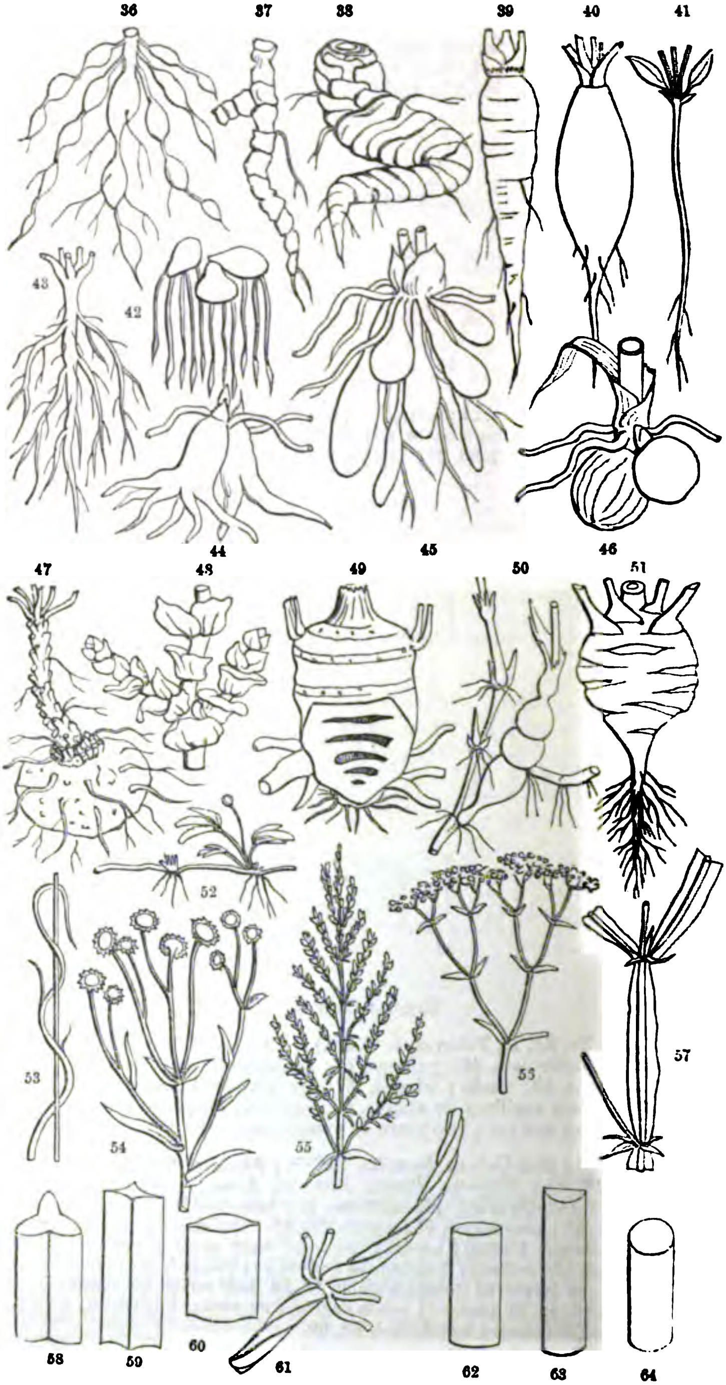
The **Point** (*Apex*) is acute, 24; acuminate, 23; obtusely acuminate, 31; obtuse, 26; retuse 25; emarginate, 30; mucronate, 35; apiculate, 27; cuspidate, 32; cirrhose, 34; truncate, or præmorse, 27; bifid, 28; bipartite, 29; tridentate, 33.



Special Terms.

The **Root** (*Radix*, SB, i.; *Tuberculum*, SB, ii.) is filiform, 41; conical, or taprooted, 39; fusiform, 40; testiculate, 46; palmate, 44; contortuplicate, 38; fasciculate, 43; clavate, 45; fibrous, 43; fleshy; ringed, 37 (*annulata*); branched, 43 (*ramosa*); knotted, 36 (*nodosa*); capillary, or simple, 42 (*capillaris, simplex*); annual, biennial, perennial, *i.e.*, lasting one year, two years, or many years.

The **Stem** (*Caulis; also Culmus, Surculus*, SB, vii.; *Rhizoma*, SB, viii., *Stolo, Cormus*, SB, v., *Tuber*, SB, iii.; *Truncus, Ramus, Ramulus, Spina*, in trees and shrubs) is turnip-shaped, 51 (*napiformis*); placentiform, 47; branched (*ramosus*); articulated, 50; dichotomous, 56; corymbose, 54; pyramidal, 55. Solid, fistular, or chambered, 49 (*septatus*); straight (*rectus*); upright (*erectus*): very erect (*strictus*); prostrate, 52; bending down (*decumbens*); twining, 53 (*volubilis*); twisted, 61 (*tortus, spiraliter tortus*); tapering, or terete, 64 (*teres*); angular, 58, 59; half terete, 63 (*semiteres*); compressed, 62; two-edged, 60 (*anceps*); acute angled, 59; obtuse angled, 58; winged, 57 (*alatus*); leaf-like (*foliaceus*); imbricated, 48, 89.


36
37
38
39
40
41
43
42
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64

The Bud, or Leafbud (*Gemma; Bulbus*, SB, ix.), is subterranean (*hypogæa*); axillary, SB, xiii.; supra axillary, or above the axil.

The Leaf (*Folium, Frons, Phyllodium, Squama*) is either deciduous or evergreen (*sempervirens*); fleshy (*succulentum*), or thin (*tenue*); papery (*papyraceum*), or like parchment (*pergameneum*); spiny (*spinosum*), or unarmed (*inerme*); stipulate, or exstipulate; radical (*radicale*), proceeding from the crown of the root; or cauline (*caulinum*), proceeding from the stem; simple (*simplex*), or compound (*compositum*).

Simple Leaves are:

orbicular, 69;
roundish, 68 (*subrotunda*);
ovate, 67;
oblate, 66;
oval, or elliptical, 77;
oblong, 75;
lozenge-shaped, 74 (*rhomboidalia*);
lanceolate, 73;
spathulate, 82;
linear, 72;
subulate, 71.
kidney-shaped, 70 (*reniformia*);
cordate, 65;
triangular, 78;
sagittate, 78*;
hastate, 88;
oblique, 87.
lobed; 3-lobed, 86; &c.
5-angled, 83 (*quinquangularia*);
erose, 84;
palmate, 85, 90;
pedate, 108;
laciniate, 91;
pinnatifid, 93;
fiddle-shaped 101 (*panduriformia*);
sinuate, 92;
dentato-sinuate;
lyrate;
sinuate backwards, 76 (*retrorsum-sinuata*);
runcinate, 76;
repand, 79;
crisp, 95.
scymitar-shaped, 98 (*acinaciformia*);
hatchet-shaped, 100 (*dolabriformia*);
deltoid, 99;
channelled (*canaliculata*);
furrowed (*sulcata*);
terete, 64;
veiny, 80 (*venosa*);
ribbed, 94 (*nervosa*);
connate, 105;
perfoliate;
amplexicaul, 96;
decurrent, 97;
fasciculate, 114;
imbricate, 89;
peltate, 81;
equitant; sword-shaped (*ensiformia*), *i. e.*, having the form of the blade of a straight sword.

Compound Leaves are:

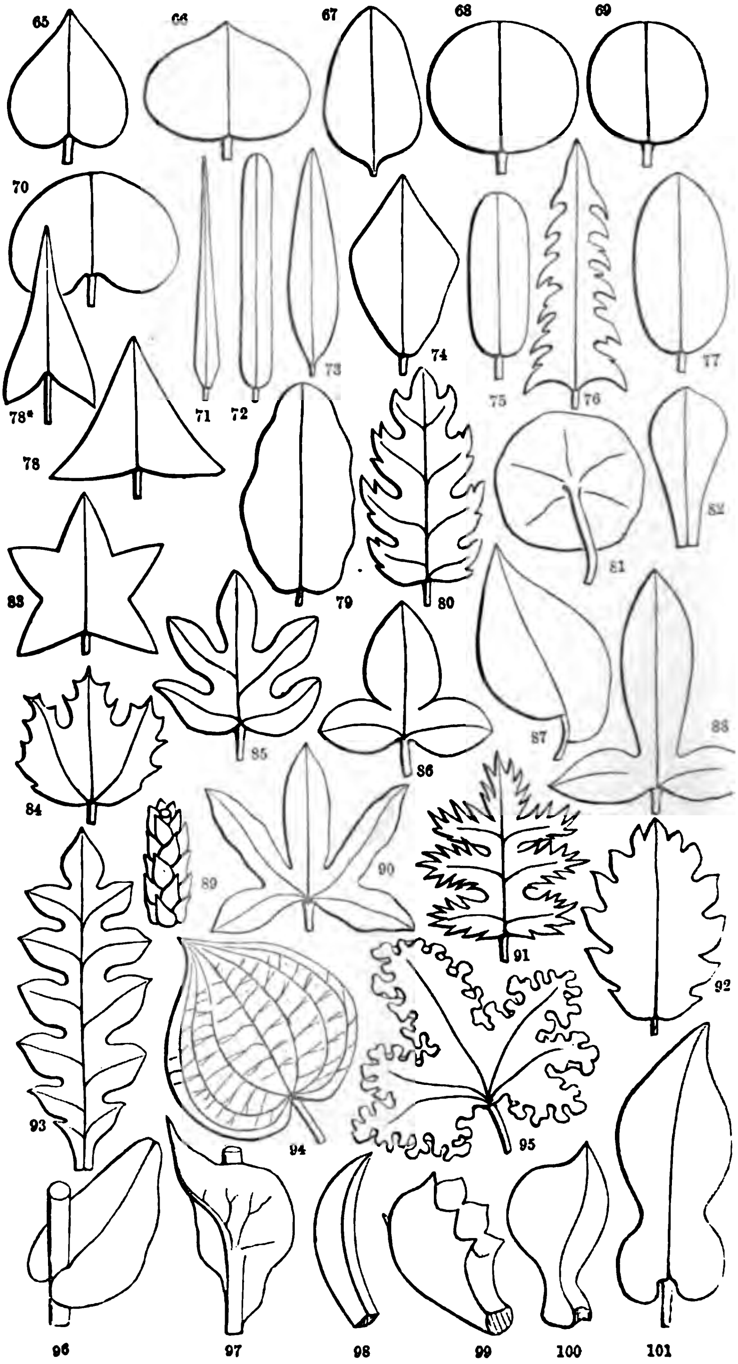
binate, 103;
conjugate, 103;
ternate with sessile leaflets (*t. foliolis sessilibus*); ternate with stalked leaflets, 104 (*t. fol. petiolatis*);
digitate 102;
pinnate, unequally, 107 (*cum impari*); abruptly, 106: alternately, 109; interruptedly; decurrently (*decursivè*); with joints, 112 (*articulate*);
biternate, 111;
triternate, 113;
bipinnate, 115;
tripinnate, 116;
supradecompound, 110.

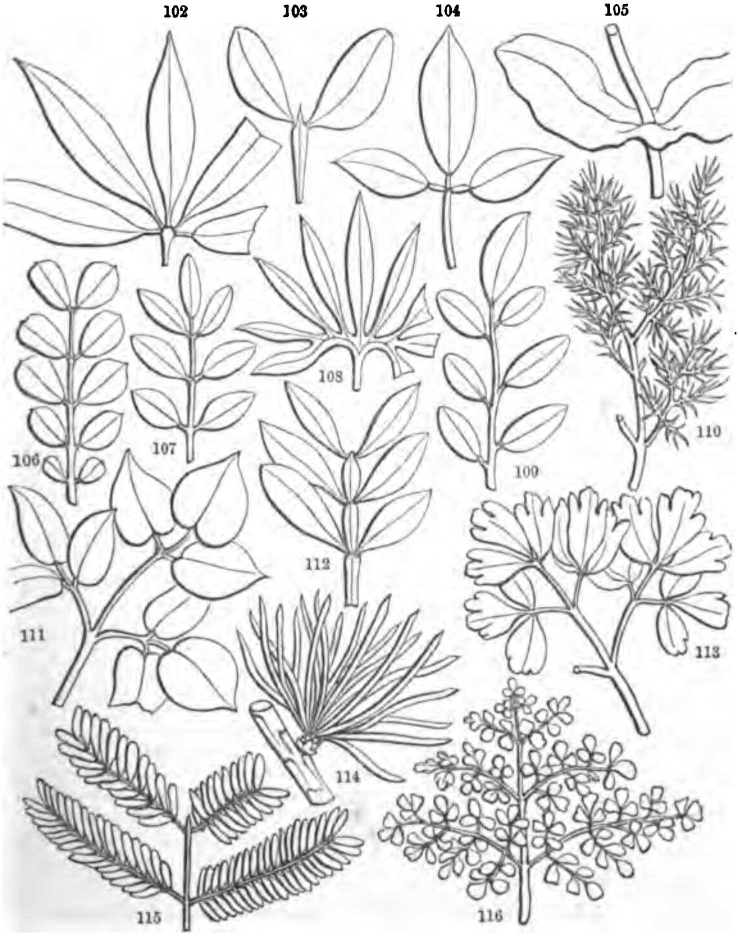
The Circumscription of a leaf is its general outline, indentations being disregarded.

Stipules are described by the same terms as leaves, when their quality is the same. They are also free (*liberæ*) when separate from the petiole: adnate when united to the petiole; lateral; axillary; supra-axillary; foliaceous when like leaves; scarious when membranous; ochreate; interpetiolar; intrapetiolar; connate.

The Petiole (*Petiolus*) is leafless (*aphyllus*); channelled (*canaliculatus*); bordered (*marginatus*); leafy (*foliaceus*); winged (*alatus*); jointed (*articulatus*); compressed; inflated (*ventricosus*); amplexicaul; eared (*auriculatus*); cirrhose when ending in a tendril; mucronate when ending in a hard point. The Vagina, a thin petiole which rolls round the stem, is entire (*integra*) when quite closed up; or slit (*fissa*) when open on one side.

Bracts (*Bracteæ; Bracteolæ*) are leafy, coloured, persistent, deciduous (*caducæ*), crested (*cristatæ*), as in Melampyrum; flat, or keeled (*carinatæ*); folded flat (*conduplicatæ*); and so on. The Coma, or tuft, appearing beyond the flowers, is coloured or herbaceous. The Spathe is hooded (*cucullata, convoluta*), as in Arum; membranous, as in Crocus and Narcissus; 1-valved if single, 2 or 3-valved if consisting of 2 or 3 bracts. The Involucre is monophyllous when all the bracts are united by their edges, polyphyllous when distinct; imbricated; recurved; calyculate when the outer bracts are suddenly much shorter than the inner; general when it belongs to the whole inflorescence, partial when proper to a portion only of the inflorescence.

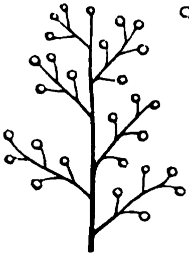

65
66
67
68
69
70
71
72
73
74
75
76
77
78ª
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101

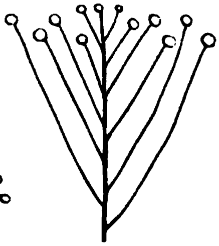


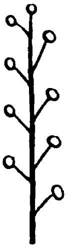
Flowers are :

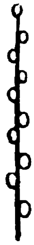
- loose (*laxi*);
- close (*densi*);
- erect;
- nodding (*nutans*);
- pendulous;
- secund;
- verticillate;
- remote;
- depauperate, when they become abortive;
- regular;
- irregular;
- symmetrical;
- unsymmetrical;
- monochlamydeous;
- dichlamydeous;
- achlamydeous, or naked;
- apetalous;
- monœcious;
- diœcious;
- polygamous.

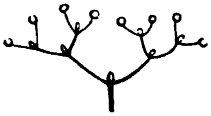
The Inflorescence (*Spica*, SB, xxxviii.; *Capitulum*, SB, clix.; *Racemus*, SB, xxxvii.; *Corymbus*, SB. c; *Umbella*, SB, xxxix. lx.; *Panicula*, SB, ccxxxvii.; *Cyma*, SB, xli, each forming its own adjective, as spicate, 120; capitate, 124; racemose, 119; corymbose, 118; umbellate, 122, 123; paniculate, 117; cymose, 121;) is dense; loose (*effusa*); terminal; axillary; opposite to the leaf (*oppositifolia*); erect; drooping; scorpioid, or gyrate.

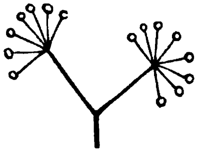
117


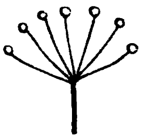
118


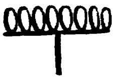
119


120


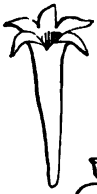

121

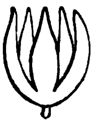

122

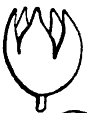

123

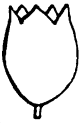

124

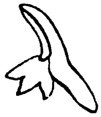
The CALYX and COROLLA (*Perianthium*, when the two become undistinguishable). The terms used in describing one of these organs are for the most part applicable to the other. They are regular, 131; irregular, 130; labiate, 129; ringent; galeate, 133; dentate, 128; cleft, 127 (*fissus*, *bifidus*, *trifidus*, &c.); parted, 126 (*bipartitus*, *tripartitus*, &c.); Monosepalous, —petalous; polysepalous, —petalous; valvate, or imbricated; ventricose, or inflated. Persistent; deciduous. Tubular; prismatical, or angular; rotate, 140; campanulate, 128; globose, 142; urceolate, 143; funnel-shaped, 125 (*infundibuliformis*); salver-shaped, 141 (*hypocrateriformis*); calcarate, 136; saccate, 135; simple at the base. The CALYX is also superior, inferior, half inferior, obsolete when scarcely discoverable. The COROLLA is also fornicate, 134, having fornices or concave scales at its orifice; contorted, 132, when its lobes are unequal-sided. Its PETALS are sessile, 138; unguiculate, 137; spoon-shaped, 139 (*cochleata*), as in Rhamnus, or scale-like (*squamiformia*), as in Ribes; cruciate as in Crucifers.

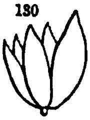
125


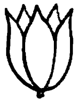
126


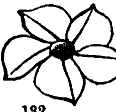
127


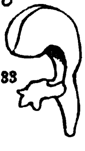
128


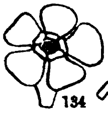
129


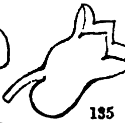
130


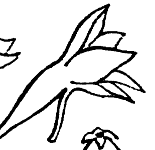
131


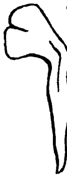

132

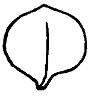
133


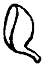

134

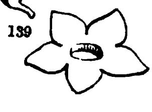

135

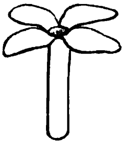

136

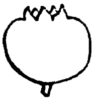

137

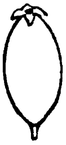

138


139

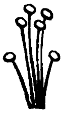

140

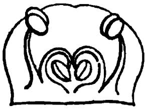

141

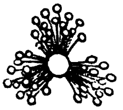

142

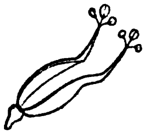

143

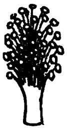
Stamens are definite or indefinite. Hypogynous; perigynous; epigynous; epipetalous. Monadelphous, 148; diadelphous, 147; polyadelphous, 146; didynamous, 145; tetradynamous, 144. Exserted; included; straight (*recta*); declinate. The **Filament** is short; long; filiform; petaloid, 151, 152, 153; unidentate; bidentate, 153; glandular; stupose, 155. The **Anthers** are 1-celled; 2-celled, 154; 4-celled. Turned inwards (*introrsæ*); turned outwards (*extrorsæ*). Innate 154; adnate, 149, 162; versatile, 161. Free (*liberæ*); syngenesious, 150. Straight; sinuous, 158. Aristate, 160; corniculate; crested, 157 (*cristatæ*). Opening by pores, 157, 159, 160 (*porosæ*); by recurved valves, 156 (*valvis recurvis dehiscentes*).

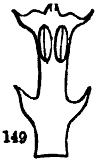
144


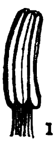
145


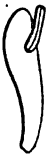
146


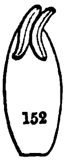
147


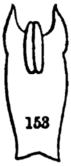
148


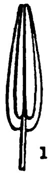

149

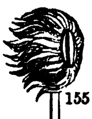

150

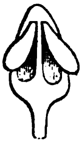

151

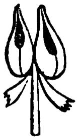

152

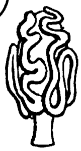

153

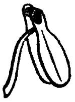

154

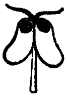

155

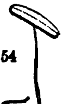

156

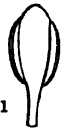

157


158

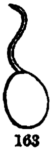

159

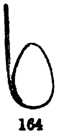

160

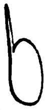

161

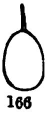

162

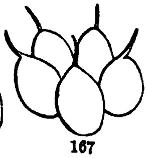
The Ovary (*Ovarium; Carpellum*) is monogynous, digynous, trigynous, &c. Superior, SB, xliv.; inferior, SB, xlv.; half-inferior. One-celled (*uniloculare*); 2- 3- many-celled (*bi- tri- multiloculare*). One-seeded (*monospermum*); 2- 3- many-seeded (*bi- tri- polyspermum*). Entire, lobed. Syncarpous, 168; apocarpous, 167. **Carpels** are definite, indefinite; united, 168; disunited, 167; spiked, SB, xci.; verticillate, SB, lxi. The **Style** is terminal, 166; lateral, 165; basal, 164 (*basilaris*). Filiform; clavate; sigmoid, 163; subulate; petaloid. Persistent; deciduous. The **Stigma** is simple, bifid, trifid, &c., capitate; pulley-shaped (*trochleare*). Terminal; lateral; transverse, as in Iris; radiate, as in Papaver; plumose, as in grasses.

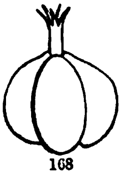

163


164

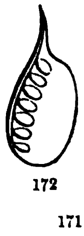
165


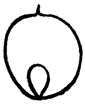

166

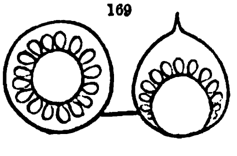

167

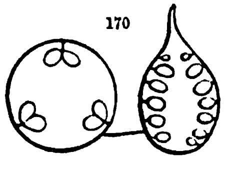

168

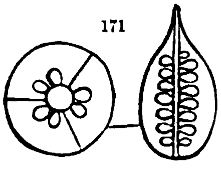
The **Placenta** is axile, 171; parietal,


172

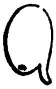

173

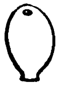
169


170


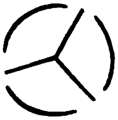
171


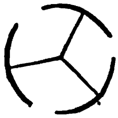
170; basal, 173; sutural, 172; free central, 169 (*libera centralis*). OVULES are erect; ascending; pendulous; suspended; horizontal. Anatropal, 174; orthotropal, 175. Definite; indefinite.

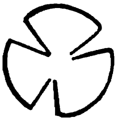

174


175

FRUIT is indehiscent (*Achænium*, *Nux*, *Drupa*, *Caryopsis*, *Bacca*, *Samara*, SB, lxxv.; *Lomentum*, SB, cxxi. 1), or dehiscent (*Capsula; Siliqua*, SB, lxxiii.; *Legumen*, *Follicle*, SB, lxxxviii.; *Pyxis*, SB, lxxiv.). It dehisces by pores or valves; its dehiscence is loculicidal, 177; septicidal, 178; septifragal, 176. It is also naked; coronetted (*coronatus*); corticate when the outer layer separates spontaneously. Monococcous, dicoccous, &c., when it splits spontaneously in the septicidal manner.


176

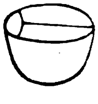

177


178

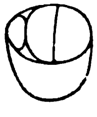
[In Umbellifers and Composites special terms are employed, some of the more important of which are the following:—Among UMBELLIFERS, the achænium divides into two carpella (*mericarpia*), which are half-terete; hemispherical; compressed laterally; compressed dorsally; rostrate. Their ridges (*juga*) are filiform; winged; wavy; corky (*suberosa*); marginal; entire; lacerated; fringed; membranous. The vittæ are commissural when on the commissure. The albumen is solid or convolute. See SB, 67.——Among COMPOSITES the achæne is beaked (*rostratum*); erostrate, or beakless; crowned (*coronatum*); sessile; stipitate; terete; top-shaped (*turbinatum*); furrowed; winged; bald (*calvum*) when there is no pappus. The PAPPUS is sessile; stipitate; membranous; paleaceous; awned (*aristatus*); setaceous; feathery ((*plumosus*); rough (*scaber*); hair-like (*pilosus*); persistent; deciduous. The receptacle is paleaceous; naked; hairy; fringed; alveolate; flat; concave; conical. See SB, 82.)]

In the SEED the same terms are employed as in the ovule, when referring to position, number, structure, or placentation. Seeds are also terete; spherical; angular; winged (*alata*); naked; pitted (*scrobiculata*); netted (*reticulata*); smooth; striated; polished (*polita*, *nitida*); hairy; shaggy (*villosa*); cottony (*lanata*); brittle (*crustacea*); comose (*comata*) having long hairs at one end; like sawdust (*scobiformia*), as in Orchis; albuminous; exalbuminous. The ALBUMEN is horny (*corneum*); fleshy (*carnosum*); oily (*oleosum*); mealy (*farinaceum*); solid; ruminate; scanty; copious. The EMBRYO is monocotyledonous; dicotyledonous; polycotyledonous; acotyledonous, as in Cuscuta; straight; annular, 184; spiral, 183; external, or lateral, 182; internal; minute; large; in the axis (*axilis*). The RADICLE is directed to the apex of the fruit (*superior*); or towards the base (*inferior*); or vague. The COTYLEDONS are semiterete; plano-convex; flat (*planæ*); spiral, 181; channelled (*conduplicatæ*); crumpled, 185 (*contortuplicatæ*), as in Convolvulus; accumbent, 179, or incumbent, 180, in Cruciferæ.

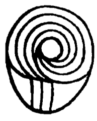
179



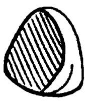
180



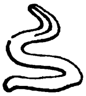
181



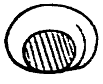
182

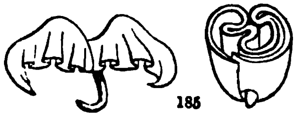


183



184




185

CHAPTER VII.

EXAMPLES OF TECHNICAL DESCRIPTION FOR EXERCISE.

The following examples have been prepared from plants so common that all may obtain them, in order that a student may never be at a loss for materials for exercise. It will be seen that although they follow in general the plan pointed out at p. 9. yet they have been made to differ among themselves in small details. This shows the student that he is not absolutely bound down to an inexorable routine, but that a deviation from the ordinary rules of description is allowable within certain limits, as for example is to be seen in *Daucus Carota*, p. 24; and that even the natural sequence of matter may be to some extent disregarded.

As soon as the student feels strong enough to attempt description, and has mastered the instructions in chapters I. to V., he should take some simple case, such as that of *Stellaria media*, or *Syringa vulgaris*, and carefully compare its description in this little work with the plant itself. Having done this he should shut his book, and himself describe the plant as he best can. Afterwards upon comparing his own description with that prepared as his guide, he will see what he has misunderstood or overlooked. And if this is practised with moderate diligence the important art of Botanical description will be speedily mastered sufficiently for all common purposes.

RANUNCULUS BULBOSUS: Buttercups.

THALAMIFLORAL EXOGENS. *Nat. Order*, RANUNCULACEÆ, or CROWFOOTS.

ROOTS nearly simple, fibrous, from the base of a roundish perennial *corm*.

STEM erect, silky, pale green, slightly branched, and angular.

LEAVES pale green, very hairy; RADICAL triternately pinnatifid, with a somewhat oblong circumscription, with long slender petioles dilated at the base into a membrane; CAULINE like the radical, but with fewer divisions, narrower lobes, and much shorter petioles more membranous at the base; the uppermost either opposite or alternate and tripartite.

FLOWERS terminal, solitary, on long angular and furrowed peduncles.

SEPALS 5, oval, shaggy, coloured at the edge, reflexed.

PETALS 5, roundish, concave, much larger than the sepals, as if varnished on the upper side, with a small wedge-shaped scale at the base.

STAMENS indefinite, hypogynous; *filaments* yellow, very narrow, spathulate; *anthers* linear, extrorse, adnate.

CARPELS indefinite, disunited, collected in a nearly spherical head, pale green; *ovaries* smooth, compressed; *stigmas* sessile, linear, recurved; *ovules* solitary, ascending.

ACHÆNES brown, compressed, smooth, monospermous.

SEED ascending; *embryo* minute, in firm fleshy albumen; *radicle* inferior.

HYPERICUM PERFORATUM: Pierced St. John's Wort.

THALAMIFLORAL EXOGENS. *Nat. Order*, HYPERICACEÆ, or TUTSANS.

ROOT woody, somewhat creeping.

STEM bushy, corymbose, much branched, terete, with two opposite ribs.

LEAVES very numerous, opposite, elliptical, obtuse, about 3-ribbed, filled with numerous transparent cysts, which give them a dotted appearance.

FLOWERS in threes, at the ends of the numerous corymbose branches; that in the middle nearly sessile, the others pedicellate.

SEPALS 5, linear, cuspidate, smooth.

PETALS 5, oblong, unequal-sided, bright yellow, with numerous marginal and immersed black glands.

STAMENS indefinite, hypogynous, slightly triadelphous; *filaments* filiform; *anthers* roundish, with a black gland on the connective.

OVARY superior, oblong, 3-celled, with polyspermous axile placentæ; *styles* 3, filiform, spreading; *stigmas* simple.

CARDAMINE PRATENSIS: Cuckoo Flower.

THALAMIFLORAL EXOGENS. *Nat. Order*, BRASSICACEÆ, or CRUCIFERS.

ROOTS fibrous, slightly branched; proceeding from the sides of a half-subterranean, perennial, green *tuber*, whose sides are marked by wide scars and very short tooth-like branches.

STEM erect, annual, smooth, terete, about a foot high.

LEAVES: RADICAL on long stalks, thin, dark green, distantly pinnate; *leaflets* stalked, in 2 to 4 pairs, sometimes alternate, wavy, orbicular, entire, angular, or toothed; the terminal one much larger than the other; CAULINE more closely pinnate in from 5 to 7 pairs with an odd one; *leaflets* linear, obtuse, entire.

RACEMES terminal and axillary, 2 or 3, nodding, longer than the leaves, somewhat corymbose, ebracteate.

SEPALS 4, oblong, obtuse, membranous at the edge: the two opposite slightly saccate.

PETALS 4, cruciate, pale lilac or white, veiny, with a slight tooth on one side of the unguis.

STAMENS tetradynamous, hypogynous, erect, longer than the calyx; *filaments* subulate, rigid, somewhat herbaceous; the two lateral much shorter than the others; *anthers* ovate, innate, erect, opening longitudinally: those of the longer filaments extrorse, of the shorter introrse.

OVARY superior, terete, as long as the longest filaments, 2-celled: *placentæ* 2 in each cell, next the dissepiment, parietal, polyspermous: *style* very short; *stigma* capitate.

DISK: four minute green glands; one surrounding the base of each shorter stamen, one free, between the bases of each pair of longer stamens.

FRUIT [so rarely produced that I never saw a specimen of it. That of the *Cardamine hirsuta* is here described instead.] SILIQUA linear, compressed, slightly torulose; *valves* thin, flat.

SEEDS oblong, lenticular, bright brown, arranged in a single line, suspended from very short funicles.

EMBRYO exalbuminous, with a superior radicle as long as the accumbent cotyledons.

STELLARIA MEDIA: Chickweed.

THALAMIFLORAL EXOGENS. *Nat. Order*, CARYOPHYLLACEÆ, or SILENADS.

ROOT annual, with numerous small fibres.

STEM of very variable length, copiously branched from the bottom, loosely spreading, leafy, brittle, smooth, except a hairy unilateral line, which proceeds from the axil of one leaf to the junction of the leaves above, and then exchanges at every joint into the axil of another leaf.

LEAVES stalked, ovate, acute, wavy, with channelled fringed petioles as long as the laminæ.

FLOWERS small, solitary, axillary; on slender, erect, shaggy peduncles, which are not half the length of the leaves, and are curved downwards and much lengthened after flowering.

SEPALS 5, ovate, obtuse, bright green, with a membranous margin and shaggy back.

PETALS 5, white, bipartite, shorter than the sepals.

STAMENS usually 4, but also 3, 5, or 10, hypogynous, each with a gland at the base on the outside; *filaments* filiform, the length of the ovary; *anthers* roundish, pale purple, 2-celled, innate, dehiscing longitudinally.

OVARY superior, oblong, 1-celled, with a free polyspermous central placenta; *stigmas* 3, linear, spreading, sessile.

CAPSULE membranous, half six-valved, enclosed in the calyx.

SEEDS about 6, pale brown, round, on long funicles, compressed, with numerous circular scabrous striæ. *Testa* crustaceous.

EMBRYO terete, annular, round mealy albumen; *radicle* inferior.

FRAGARIA VIRGINIANA: The Garden Strawberry.

CALYCIFLORAL EXOGENS. *Nat. Order*, ROSACEÆ, or ROSEWORTS.

STEM woody, perennial, subterranean, covered with brown scales, throwing out strong, perpendicular, yellowish, fibrous roots; and long weak runners rooting at the joints.

LEAVES all radical, ternate, dark green, somewhat shining, very coarsely serrated; with strong parallel oblique veins, silky beneath; *leaflets* nearly sessile, roundish oblong, entire towards the base, shorter than the semiterete hairy petioles; *stipules* membranous, lanceolate, acuminate, half adnate.

SCAPES erect, terete, silky, branched from near the middle, and corymbosely panicled. BRACTS herbaceous, oblong, close-pressed, bifid, the lowest often monophyllous, the uppermost acuminate, entire.

CALYX herbaceous, flat: *sepals*, in two whorls of 5 each; the outer oblong, frequently bidentate, the inner triangular, acuminate, entire.

COROLLA polypetalous, white, larger than the calyx; *petals* 5, roundish, inserted upon the calyx between the inner sepals.

STAMENS indefinite, perigynous: *filaments* short, stiff; *anthers* oval, cordate, flat, dehiscing at the edges.

CARPELS indefinite, distinct, upon an oblong elevated torus; *ovaries* oblong, rather oblique; *ovules* solitary, ascending; *styles* erect, filiform, yellowish; *stigmas* simple.

FRUIT a large succulent conical or hemispherical torus, having a persistent calyx at the base, and bearing on its surface the half immersed wrinkled achænes. *Seed* solitary ascending; *embryo* exalbuminous, with plano-convex *cotyledons*, and a short inferior *radicle*.

[OBS. This description applies to the common state of the Garden Strawberry, when nearest its original state; but its varieties are very numerous, differing not only in the form, colour, and quality of the fruit, but in the form of the leaflets, their surface and colour, and in the degree of hairiness of all the parts.]

CRATÆGUS OXYACANTHA: The Hawthorn tree.

CALYCIFLORAL EXOGENS. *Nat. Order*, ROSACEÆ, § POMEÆ.

A small TREE, with a round entangled branching head; *trunk* with numerous irregular longitudinal fissures; *branches* dark grey, smooth, with numerous simple spines; *twigs* pale green, terete, smooth.

LEAVES alternate, deciduous, stalked, 3- to 5-lobed, with the lobes apiculate, often serrated and incised; smooth except a few silky hairs chiefly along the midrib on the underside; *petioles* slender, channelled, rather shorter than the lamina; *stipules* free, leafy, acuminate, those of the first leaves falcate, coloured on the inner edge, the rest linear-lanceolate, glandular at the edge, sometimes half-hastate at the base.

CORYMBS axillary and terminal, panicled, silky, with setaceous coloured deciduous *bracts*.

CALYX superior, 5-lobed; the lobes triangular, reflexed; the tube, obconical woolly.

PETALS 5, roundish, concave, inserted into the edge of the tube of the calyx, imbricated in æstivation.

STAMENS indefinite (about 20) perigynous; *filaments* white, filiform, curving inwards; *anthers* 2-celled, roundish, innate, reddish purple.

OVARY inferior, wholly buried in the tube of the calyx, 1-2-celled; *ovules* 2 in each cell, ascending, anatropal; *styles* 1 or 2, filiform, smooth; *stigmas* simple.

[OBS. This description applies to the common form of the Hawthorn; but it varies much in the form of its leaves, their downiness, and other small details.]

DAUCUS CAROTA: The Wild Carrot.

CALYCIFLORAL EXOGENS. *Nat. Order*, APIACEÆ, or UMBELLIFERS.

ROOT biennial, slender, tapering, yellowish, aromatic, and sweetish.

STEM 2 or 3 feet high, branched, erect, leafy, hairy, scabrous.

LEAVES alternate, on broad, concave, ribbed footstalks, bipinnate, with narrow, very acute, entire or cut, pilose segments, rough at the edge.

UMBELS terminating long leafless branches, solitary, large, white, except one central neutral flower, which is blood-red.

BRACTS OF GENERAL INVOLUCRUM pinnatifid, setaceous, not so long as the umbel; of the PARTIAL, simple, or 3-cleft, membranous at the edges.

CALYX obsolete.

PETALS 5, obovate, flat, unequal; the larger next the circumference of the umbel.

STAMENS 5, inserted beneath a double epigynous disk; *filaments* filiform, incurved; *anthers* oblong, 2-celled, dehiscing longitudinally.

OVARY inferior, roundish, striated, hispid, 2-celled; *ovules* solitary, pendulous; *styles* 2, erect, filiform, shorter than the stamens; *stigmas* simple.

FRUIT (protected by the incurvation of all the flower-stalks, by which the umbels are rendered hollow, like a bird's nest. *Smith*), compressed from the back, pale dull brown, oval; of the *primary* ridges, which are narrow, 3 bristly, near the middle of the convex back, the other 2 on the edge of the narrow commissure; *secondary* deeper and irregularly split into setaceous lobes; *vittæ*, 1 under each secondary ridge, and 2, more slender, on the plane of the commissure.

[OBS. 1. The cultivated Carrot, which is a domesticated variety of this, has broader leaves, and differs in some other small particulars.]

[OBS. 2. In examining the fruit of any Umbellifer, obtain a thin transverse slice, just when it is beginning to harden, place it in water, and view it by transmitted light. If the fruit is old and hard, it must be boiled for two or three minutes before being sliced.]

ÆTHUSA CYNAPIUM: Fool's Parsley.

CALYCIFLORAL EXOGENS. *Nat. Order*, APIACEÆ, or UMBELLIFERS.

ROOT annual, tapering, whitish.

STEM erect, dark lurid green, often purplish, fetid, terete, striated, leafy, a foot high.

LEAVES smooth, on short sheathing footstalks, ternate, with slender-stalked, tripartite, cut, somewhat cuneate lobes.

UMBELS stalked, terminal, spreading and flattish.

GENERAL INVOLUCRE 0; PARTIAL one-sided, of 3 linear, acute, pendulous bracts.

FLOWERS small, pure white, partially abortive.

CALYX obsolete.

PETALS 5, obcordate, with the points inflexed, those near the circumference largest.

STAMENS 5, epigynous, incurved.

OVARY inferior, oblong, striated, 2-celled, smooth; *ovule* solitary, pendulous; *styles* 2, spreading, short, filiform; *stigmas* simple.

FRUIT pale brown, ovate, 2 lines long, without any remains of a calyx; *ridges* thick, corky, sharp, the dorsal ones rather the narrowest; *vittæ* under the furrows solitary, very slender, upon the commissure 2, blood red, curved, more distant at the base than at the apex; *albumen* terete.

SYRINGA VULGARIS : The Lilac Bush.

COROLLIFLORAL EXOGENS. *Nat. Order*, OLEACEÆ, or OLIVEWORTS.

A large branching SHRUB or small tree, with a pale brown bark; *branchlets* opposite, smooth, slightly quadrangular.

LEAVES opposite, exstipulate, roundish-cordate, very acute, thin, smooth, rather longer than the linear channelled petiole.

PANICLES terminal, pyramidal, compact, many-flowered, slightly downy: *General Bracts* lanceolate herbaceous; *partial* subulate, or none.

CALYX herbaceous, cupshaped, 4-toothed, minutely glandular.

COROLLA monopetalous, hypocrateriform, much longer than the calyx; the limb 4-lobed, valvate in æstivation.

STAMENS 2, within the tube of the corolla, epipetalous, alternate with the lobes; *anthers* oblong, sessile, dehiscing longitudinally.

OVARY superior, ovate, seated in a fleshy disk, 2-celled; *ovules* in pairs, pendulous; *style* clavate; *stigmas* 2, linear, decurrent.

CAPSULE woody, compressed, obovate; *valves* 2, navicular, loculicidal. SEEDS solitary, thin, oblong, winged.

ILEX AQUIFOLIUM: The Holly tree.

COROLLIFLORAL EXOGENS. *Nat. Order*, AQUIFOLIACEÆ, or HOLLYWORTS.

An evergreen TREE. *Branches* dull green, slightly obtusangular, smooth.

LEAVES alternate, elliptical, wavy, veinless, smooth, shining, spinoso-dentate, with a cartilaginous edge; *petioles* short, terete, minutely tomentose.

FLOWERS nearly sessile, axillary; 3 or 4 together.

CALYX inferior, 4 parted; with rounded downy lobes.

COROLLA white, monopetalous, or polypetalous, rotate, 4-lobed; with oblong imbricated lobes.

STAMENS 4, inserted on the corolla between the lobes, or hypogynous; *filaments* stiff, erect, filiform; *anthers* ovate, obtuse, 2-lobed, innate, dehiscing longitudinally.

OVARY superior, roundish, naked, deep green, 4-celled; *ovules* solitary suspended; *stigmas* 4, simple, sessile, confluent. [N.B. The ovary is often abortive, and 4-lobed, without stigmas.]

PRIMULA ACAULIS: The Primrose.

COROLLIFLORAL EXOGENS. *Nat. Order*, PRIMULACEÆ, or PRIMWORTS.

ROOTS fibrous, rather strong and fleshy, proceeding from the sides of a short, very scaly, perennial stem.

LEAVES numerous, all radical, obovate-oblong, rugose, unequally toothed, soft and somewhat downy, narrowing gradually downwards into broad short footstalks.

FLOWERS axillary, solitary, with terete shaggy peduncles, about half the length of the leaves, curving downwards after flowering.

CALYX tubular, prismatical, 5-fid, a little contracted at the orifice, as long as the tube of the corolla, with acuminate teeth, and the angles covered with long soft hairs.

COROLLA large, monopetalous, hypocrateriform, as long as the calyx, or a little longer; *limb* 5-lobed, equal, sulphur-coloured, with a bright yellow spot at the base of each of the lobes, which are flat, obcordate, and nearly as long as the tube.

STAMENS 5, inserted about the middle of the tube, opposite the lobes of the corolla, nearly sessile; *anthers* 2-celled, innate, ovate, introrse, dehiscing longitudinally.

OVARY superior, roundish, 1-celled, with a polyspermous free central placenta; *style* filiform, scarcely reaching the stamens; *stigma* capitate.

CAPSULE globular, enclosed in the persistent calyx, 10-furrowed, 5-valved at the apex; the valves usually bidentate.

SEEDS indefinite, roundish, depressed, somewhat angular in consequence of mutual pressure, finely dotted.

EMBRYO dicotyledonous, terete, lying in the axis of fleshy albumen, across the hilum.

MYOSOTIS PALUSTRIS: Forget-me-not.

Corollifloral Exogens. *Nat. Order*, Boraginaceæ, or Borageworts.

Rhizomes long, creeping, blackish, with numerous tufts of strong fibres.

Herb bright green, rather succulent, from 6 to 12 or 18 inches high.

Stems ascending obliquely, terete, branching, leafy, either nearly smooth or clothed with more or less spreading bristly hairs.

Leaves sessile, nearly uniform, elliptic-oblong, bluntish, 1½ or 2 inches long, clothed on both sides with small close-pressed bristles, which scarcely render them rough to the sight or touch.

Racemes scorpioid, many-flowered, 2 or 3 together, on a terminal leafless stalk or elongation of each branch; each general and partial stalk, as well as both sides of the calyx, clothed with erect, or close-pressed, short, straight, simple, rigid, pale, uniform, bristly hairs; *pedicels* at first crowded into a dense revolute spike, which unrols gradually, and after flowering is greatly elongated, the stalks spreading almost horizontally as the achænes ripen, forming a very lax straight raceme.

Calyx about half the length of each pedicel, after the flower is past, bell-shaped at the base; the *limb* divided half-way down into 5 broad, triangular, rather expanding segments.

Corolla: *tube* about as long as the calyx, whitish; *limb* longer, horizontal, pink before expansion, then of a beautiful enamelled sky blue, with white elevated ribs at the base of each rounded, scarcely notched segment; the *fornices* yellow.

Stamens 5, alternate with the lobes of the corolla, included within the tube; *anthers* purplish brown, oblong, 2-celled.

Ovary superior, 4-lobed; *style* basal, the length of the tube of the corolla; *stigma* capitate, umbilicated. (*Smith, a little modernised.*)

Achænes ovate, obtuse, blackish, highly polished, erect, rounded at back, slightly keeled in front, with a small scar at the base, by which they are attached rather obliquely to the *torus*.

Seed solitary, fixed by the middle, exalbuminous, dicotyledonous, with a superior *radicle*.

VERONICA CHAMÆDRYS: The Germander Speedwell.

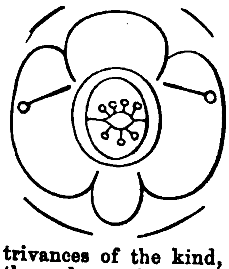
Corollifloral Exogens. *Nat. Order*, Scrophulariaceæ, or Linariads.

Stems ascending, branched, terete, with two hairy lines on opposite sides.

Leaves opposite, sessile, ovate, slightly cordate, obtuse, rugose, pilose, coarsely serrated.

Racemes axillary, erect, drooping at the point; *peduncle* naked, twice as long as the leaves; *bracts* ovate, acute at base, entire, herbaceous, ciliated, rather shorter than the hairy pedicels.

Calyx spreading, 4-parted, rather unequal, with two of the lobes larger than the others.



Corolla rotate, light blue with darker veins, unequally 4-parted; lobes roundish, two external and larger, of the two inner the smaller alternate with the two larger lobes of the calyx; tube hairy inside.

Stamens 2, spreading, at the base of the larger of the two inner lobes of the corolla; *filaments* violet, clavate; *anthers* innate, 2-celled, dehiscing longitudinally.

Ovary superior, compressed laterally, in a yellow annular disk; cells 2, anticous and posticous; *ovules* several, axile; *style* filiform, declinate; *stigma* capitate.

[Obs. The accompanying diagram, which represents this structure, is a good example of the utility of contrivances of the kind, in making which students should constantly exercise themselves. See SB, lxviii. and lxix.]

LAMIUM ALBUM: White Deadnettle.

COROLLIFLORAL EXOGENS. *Nat. Order*, LAMIACEÆ, or LABIATES.

STEM creeping, rooting at the joints, decumbent, quadrangular, with thickened angles, fistular, 1 to 2 feet high, slightly hairy.

LEAVES with a heavy smell, opposite, rugose, coarsely serrated, hairy; the lower cordate-ovate, obtuse, about as long as the linear channelled petioles; the upper larger, nearly sessile, acuminate.

FLOWERS about 6, sessile in the axils of all the upper leaves.

CALYX monosepalous, campanulate, irregular, pilose, green, purple at base, with a wide 5-cleft limb, having triangular setaceous lobes, of which the uppermost, at the back of the galea, stands apart from the others.

COROLLA large, white, monopetalous, bilabiate, with a ventricose tube rather longer than the calyx; scabrous inside down to an oblique ring of hairs which stands over the ovary; upper lip galeate, entire, villous, arching over the lower lip, which is 3-lobed, with roundish erect cuspidate lateral lobes, and a deflexed two parted middle lobe rounded at the sides.

STAMENS 4, didynamous, epipetalous, beneath the galea; *filaments* downy and glandular; *anthers* dark purple, with a wide shaggy connective, and horizontal lobes, dehiscing longitudinally; *pollen* yellow.

OVARY truncate, 4-lobed, pale green, seated in a pale fleshy cup-like disk; *ovules* solitary, erect; *style* basal, terete, thickened upwards, lying between the filaments beneath the galea, smooth; *stigma* acutely bifid.

ACHÆNES 4, cuneate, as long as the tube of the persistent calyx, triangular, rounded at the back, truncate and concave at apex, smooth, shining; *seed* solitary, erect; *embryo* exalbuminous, with plano-convex *cotyledons* and a short inferior radicle.

NEPETA GLECHOMA: Ground Ivy.

COROLLIFLORAL EXOGENS. *Nat. Order*, LAMIACEÆ, or LABIATES.

STEMS numerous, slender, quadrangular, purplish, with a few recurved minute hairs; decumbent and rooting at the joints, which have a fringe of long hairs between the leaves.

LEAVES opposite, the lower reniform, the upper roundish-cordate, crenate, somewhat rugose, hairy and ciliated, rather longer than the channelled petioles.

FLOWERS in threes, axillary, nearly sessile: *bracts* scaly, acute.

CALYX cylindrical, slightly irregular, striated, glandular, hairy; with 5 ovate cuspidate teeth, much shorter than the tube of the corolla.

COROLLA monopetalous, slightly 2-labiate, deep violet, with the tube somewhat ventricose in front; *lobes* rounded, *upper lip* flat, 2-lobed, *lower* 3-lobed: the middle lobe broader and retuse, with a few hairs at its base.

STAMENS didynamous, distinct, included, two much shorter than the others (often abortive).

OVARY 4-lobed, on a fleshy disk, the lobes roundish; *style* filiform, basal, ascending, lying in a furrow along the middle of the upper lip of the corolla; *stigma* bifid, acute.

ACHÆNES 4, oblong, smooth, very minutely punctured.

BELLIS PERENNIS: The Daisy.

Corollifloral Exogens. *Nat. Order*, Asteraceæ, or Compositæ.

Root perennial, of numerous perpendicular, nearly simple fibres.

Stem very short, branching at the crown and spreading horizontally.

Leaves numerous, all radical, spreading, horizontal, obovate, acutely crenate, deep green, slightly hairy especially beneath, tapering into a thin channelled fringed petiole.

Scapes radical, ascending, simple, terete, hollow, pubescent, naked, monocephalous, (i.e. each bearing a solitary flowerhead or *capitulum*).

Involucre deep green, hemispherical, hairy, of about 12, linear, obtuse bracts in two rows.

Florets; of the ray white, ligulate, blunt, in about 3 rows, neuter; of the disk, yellow, tubular, hermaphrodite; *ovary* oval, compressed, without pappus; *corolla* funnel-shaped, 5-lobed, slightly hairy at the base; *anthers* syngenesious, yellow, simple at base; *style* filiform; *stigma* 2-fid, with short acute plano-convex lobes.

Receptacle conical, hollow, naked.

SENECIO VULGARIS: Common Groundsel.

Corollifloral Exogens. *Nat. Order*, Asteraceæ, or Compositæ.

Root annual, simple, with many long slender fibres.

Stem erect, more or less branched, terete, slightly striated, pale green.

Leaves succulent, with a few weak scattered hairs, which also occur on the stem; radical obovate or spathulate, obtusely lobed, and slightly toothed; cauline sessile, bluntly pinnatifid, unequally toothed, at the base broader and amplexicaul.

Flower-heads solitary, in the axils of the uppermost leaves, clustered, with short arachnoid peduncles; *involucrum* somewhat cylindrical, eventually turned back upon the peduncles; *bracts* at the base triangular and sphacelated, the rest linear, acute, erect, sphacelated at the point; *florets* all tubular and hermaphrodite.

Corolla slender, funnel-shaped, yellow.

Stamens with yellow syngenesious anthers.

Ovary inferior minute, oblong, smooth; *style* filiform; *stigmas* 2, linear, truncated. *Pappus* soft, pilose.

Receptacle flat, hollow, naked, eventually convex.

Achænes fusiform, striated, minutely pubescent, with weak, spreading, silky pappus.

TARAXACUM DENS LEONIS: The Dandelion.

Corollifloral Exogens. *Nat. Order*, Asteraceæ, or Compositæ.

Root tap-shaped, milky, externally black when old.

Leaves all radical, numerous, spreading, bright shining green, quite smooth, thin, milky, narrowing downwards, pinnatifid, with unequally toothed runcinate lobes.

Scapes usually longer than the leaves, erect, smooth, brittle, leafless.

Flower-heads solitary, calyculate; the outer scales of the *involucre* several, linear, acute, loosely recurved and wavy; inner erect, in one row, deep green, somewhat coloured and jagged at the point; finally, bent down upon the scape.

Florets all ligulate and hermaphrodite.

Corolla 5-toothed, bright yellow, in the ray olive green at the back; in the disk shorter and whole coloured.

Stamens 5, with yellow syngenesious sagittate anthers.

Ovary inferior, compressed, smooth, white, a little scabrous at the top; with a very short terete rostrum, one-celled, with a single ascending ovule; *style* filiform, pubescent on the upper half; *stigmas* 2, projecting beyond the anthers, linear, recurved. *Pappus* hair-like (pilose), in several rows, scabrous.

Receptacle flat, naked.

Achænes linear-obovate, slightly compressed, toothed near the apex, extended into a slender terete beak twice their own length. *Pappus* spreading horizontally, pilose.

[Obs. This plant varies greatly in its foliage.]

POLYGONUM HYDROPIPER: Biting Persicaria.

MONOCHLAMYDEOUS EXOGENS. *Nat. Order*, POLYGONACEÆ, or BUCKWHEATS.

ROOTS fibrous, annual.

STEMS erect, about 2 feet high, branched, smooth, terete, reddish, rather tumid at the nodes.

LEAVES ovate-lanceolate, wavy, nearly sessile, pale green, whole-coloured, smooth; *ochreæ* brown, truncate, with a few marginal bristles.

RACEMES numerous, slender, spicate, drooping from the axils of all the upper leaves, leafy and interrupted at the lower part. *Bracts* stipulary, truncate, membranous, cucullate, coloured, about as long as the pedicels.

CALYX monosepalous, 4-5-lobed, imbricated, coloured at the edge, glandular on the sides.

COROLLA 0.

STAMENS usually 6, nearly hypogynous, shorter than the calyx.

OVARY superior, oval, 1-celled; *ovule* solitary, erect, orthotropal; *styles* 2 or 3; *stigmas* capitate, coloured.

ACHÆNE monospermous, compressed, oval, acute, purplish, crustaceous. *Seed* erect; *embryo* lateral, terete, curved, on the outside of mealy albumen, with a superior *radicle.*

JUGLANS REGIA: The Walnut Tree.

MONOCHLAMYDEOUS EXOGENS. *Nat. Order*, JUGLANDACEÆ, or JUGLANDS.

A large **TREE.**

BRANCHES, when young, terete, bright olive green, smooth and shining; after the first year grey, with globular black somewhat downy buds, large transverse scars and a chambered pith.

LEAVES close together, alternate, aromatic, unequally pinnate, with about 4 pairs of nearly opposite oblong sessile entire deep green shining *leaflets*, oblique at the base; the terminal one petiolate.

FLOWERS monœcious.

MALES in dense cylindrical pendulous solitary sessile catkins. *Calyx* unequal, herbaceous, about 5-parted, having a small bract adnate to its back.

> **STAMENS** about 15; *anthers* sessile, herbaceous, becoming black, extrorse, 2-celled, opening longitudinally.

FEMALES terminal, solitary, in pairs or clusters, sessile.

> **OVARY** oblong, tomentose, with a superior *calyx* consisting of about 8 small unequal herbaceous scales; 1-celled, with a solitary erect orthotropal ovule; *stigmas* 2, broad, revolute, broken up into numerous irregular crests.

DRUPES oblong, with a fleshy, leathery sarcocarp, separating freely from the putamen. The latter bony, wrinkled, composed of two equal separable half-oblong convex valves.

SEED erect, on the apex of a woody intruded axis; *Cotyledons* 2, large, 2-lobed, wrinkled; *radicle* superior, conical.

CONVALLARIA MAJALIS: The Lily of the Valley.

Petaloid Endogens. *Nat. Order*, Liliaceæ, or Lilyworts.

Rhizome slender, creeping, entangled, producing coarse fibres from its nodes.

Stem ascending, 2-leaved, clothed with 2 or 3 long membranous sheaths.

Leaves opposite, bright green, thin, elliptical, with long slender petioles, of which one fits into the groove of the other.

Scape lateral, erect, not so long as the leaves, semiterete, rather angular, terminating in a many-flowered, drooping, secund, lax raceme, with a triangular axis. Bracts membranous, acuminate, much shorter than the pedicels.

Calyx and Corolla united into an urceolate, snow white, fragrant Perianth with 6 equal spreading teeth.

Stamens 6, much shorter than the perianth, and inserted into its base; *filaments* subulate; *anthers* ovate, introrse, dehiscing longitudinally.

Ovary superior, ovate, 3-celled; *ovules* several, attached to an axile placenta; *style* cylindrical, thick, twice as long as the ovary; *stigmas* 3 hairy recurved lines.

IRIS GERMANICA: German Iris.

Petaloid Endogens. *Nat. Order*, Iridaceæ, or Irids.

Rhizome thick, very irregular, frequently contracted into unequal joints.

Leaves equitant, broadly sword-shaped, acute, slightly curved, glaucous, shorter than the *scape*, which is terete, slightly flexuose, 2 feet high, or more with two or three distant erect branches.

Bracts: general (*i.e.* at the base of the branches) membranous, herbaceous, conduplicate, carinate, incurved, slightly coloured at the edge; partial (*i.e.* next the flowers) large, membranous, cucullate, obtuse, overlying each other, somewhat herbaceous and purplish, dead at the edge towards the point.

Flowers solitary, very large, deep purple.

Perianth with a large broadly expanded limb and a short bluntly triangular tube.

Sepals 3, obovate, narrowed towards the base, where they are richly veined with deep purple on a white ground, bearded in the middle, the upper half reflexed.

Petals 3, roundish oblong, unguiculate, erect, arching over the centre of the flower; each with a pair of fleshy auricles.

Stamens 3, opposite the sepals, inserted into the tube, and concealed beneath the arched arms of the style; *filaments* subulate; *anthers* linear, sagittate, extrorse, bursting longitudinally.

Ovary inferior, oblong, bluntly triangular, 3-celled, many seeded; *ovules* indefinite, anatropal, in two rows, on an axile placenta; *style* partly confluent with the tube of the perianth, 3 winged, separating into 3 petaloid bifid arms arching backwards over the stamens; *stigma* a long transverse cleft below the lobes of the style.

LUZULA CAMPESTRIS: Field Wood-rush.

Petaloid Endogens. *Nat. Order*, Juncaceæ, or Rushes.

Rhizome tough, scaly, creeping and throwing up tufts here and there.

Stems solitary, from 3 or 4 to 10 inches high, simple, straight, terete, bearing about 2 leaves, which, like the more numerous radical ones, are flat, many-ribbed, dark green, extremely hairy at the margin, and especially at the top of the sheath.

Spikes capitate, few-flowered, 3 or 4, one of them nearly sessile, the rest on spreading, lax, simple stalks, composing a small umbel; each ovate, or roundish, of from 4 to 6 or 8 crowded, nearly sessile flowers, enveloped by membranous, partly brown, sheathing, wrinkled bracts.

Sepals and Petals 3 each, lanceolate, pointed, dark brown, with a stout ribbed keel, and pale membranous margin. (*Smith, with some alteration.*)

Stamens 6, nearly hypogynous, shorter than the sepals and petals; *anthers* introrse.

Ovary superior, triangular, roundish-obovate, bluntly one-celled; *ovules* 3, erect; *style* subulate, deciduous; *stigmas* 3, linear, spreading.

Capsule dark brown, shining, bluntly triangular, 3-valved, 3-seeded.

Seeds erect, oval, compressed, shining, strophiolate (*i.e.* with a fungous hilum).

ORCHIS MASCULA: Male Orchis.

PETALOID ENDOGENS. *Nat. Order*, ORCHIDACEÆ, or ORCHIDS.

ROOTS fleshy, simple, partly fibrous, partly testiculate, undivided.

LEAVES radical, deep green, shining, oblong-lanceolate, usually blotched with dark purple, paler on the underside.

SCAPE longer than the radical leaves, spotted with purple, with two or three sheathing leaves.

FLOWERS purple, with a few crimson spots, in a long cylindrical spike. *Bracts* lanceolate, acuminate, shorter than the ovary.

SEPALS 3, oblong; the lateral reflexed, the dorsal erect.

PETALS smaller than the sepals, but of nearly the same form, erect, arching over the column. *Lip* 3-lobed, crenulate or serrate, the lateral lobes rounded, the central retuse; *spur* cylindrical, obtuse, nearly horizontal, as long as the ovary.

COLUMN very short, with a tubercle on each side. *Anther* erect, apiculate, dehiscing in front; *pollen masses* 2, sectile, each with a long caudicle attached to a gland concealed within a common stigmatic pouch.

OVARY inferior, twisted, 1-celled, with 3 parietal polyspermous placentæ. *Stigma* concave, transverse, immediately beneath the pouch.

BROMUS MOLLIS: Soft Brome Grass.

GLUMACEOUS ENDOGENS. *Nat. Order*, GRAMINACEÆ, or GRASSES.

ROOTS fibrous, few and weak.

STEMS erect, ascending, from 1 to 2 feet high.

LEAVES narrow, clothed with long soft hairs, especially on the *sheaths*, which are shaggy; *ligula* very short.

SPIKELETS in an erect downy raceme, on erect elastic pedicels usually placed in pairs, long, narrow, slightly compressed, many-flowered.

GLUMES 2, thin, acute, the *lower* with 3, the *upper* larger with 5 obscure ribs.

PALES 2; the *lower* oblong, bidentate, about 7-ribbed, with a setaceous awn from below the point externally; the *upper* linear, membranous, obtuse, with green fringed edges.

STAMENS 3; *stigmas* 2, plumose.

POA ANNUA: Annual Meadow Grass.

GLUMACEOUS ENDOGENS. *Nat. Order*, GRAMINACEÆ, or GRASSES.

ROOT fibrous.

STEMS several, pale, very smooth, somewhat compressed, leafy, jointed, branched at the base, spreading in every direction, and taking root at many of their lower joints; their length from 3 to 12 inches.

LEAVES of a fine light green, spreading, linear, bluntish, flaccid, flat, except a crumpled portion here and there; *sheath* long, compressed, smooth; *ligula* oblong, acute or obtuse, and jagged.

PANICLE loose, rather longer than the leaves when full grown, with a somewhat secund and rather triangular outline.

SPIKELETS narrow, compressed, ovate, externally smooth, 5-6-flowered. **GLUMES** ovate, acute, the upper rather larger than the lower.

PALES 2; the lower deep green tinged with purple, ovate, obtuse, membranous at the margin; the upper narrower, bidentate, with the edges turned inwards.

STAMENS 3, hypogynous, with weak filiform *filaments* and versatile linear *anthers* 2-lobed at each end.

OVARY oblong, with 2 feathery *stigmas*.

[N.B. This is an example of the simplest mode of describing a Grass; the fruit (corn) being omitted.]

LONDON:
BRADBURY AND EVANS, PRINTERS, WHITEFRIARS.

C

FIRST LIST

OF

FLOWERING PLANTS AND FERNS

FOUND

WITHIN FOUR MILES OF THE CLOSE,

RUGBY.

This List is published incomplete, in the hope that additions will be sent to the Compiler. He would also like to have lists of the localities in which the plants are observed, with the earliest and latest dates of floweriug in any particular year. He has to thank the Rev. A. Bloxam for his aid, to whom the list of Grasses and Carices is chiefly due. The names are given in accordance with Bentham's "Handbook of the British Flora" (1865), to which work letters denoting varieties refer. Some few plants not found as yet within the limits, but easily accessible from Rugby, have been inserted in brackets. Plants of which only doubtful specimens have been seen have a query appended. Plants thought to be naturalized or escaped are printed in italics. L.C. refers to the London Catalogue of British Plants.

F. E. K., January, 1866.

RUGBY: CROSSLEY AND BILLINGTON.

- Sent up in my collection Nov. 65 –
+ Seen in 1866 –
O A good specimen mounted –

FIRST LIST OF
FLOWERING PLANTS AND FERNS.

Class I.—Dicotyledons.

I. RANUNCULUS FAMILY.

	2 Thalictrum	o	1 flavum	—	
	3 Anemone	o	2 nemorosa	—	
	4 Myosurus		1 minimus		
I. 21.	6 Ranunculus	+	1 aquatilis, var. *b*, *c*.	—	
I. 6		+	2 hederaceus	—	Bilton Pond -
			4 flammula	—	
II. 18.		o +	6 Ficaria	—	
			7 sceleratus	—	
V. 29		+	8 auricomus		[illegible] road
		o	9 acris	—	
I. 7.		o +	10 repens	—	
I. 8.		o +	11 bulbosus	—	
			12 philonotis (?)		
		o	14 arvensis	—	
III. 25.	7 Caltha	o +	1 palustris	—	
	8 Trollius		1 europæus		
	10 Aquilegia		1 vulgaris		

III. WATER-LILY FAMILY.

	1 Nuphar		1 lutea	—	

IV. POPPY FAMILY.

	1 Papaver		1 *somniferum*		
			2 Rhœas	—	
			3 dubium	—	
			5 Argemone	—	
	2 Chelidonium		1 majus		

V. FUMITORY FAMILY.

I. 8.	1 Fumaria	+	1 officinalis	—	

VI. CRUCIFER FAMILY.

	3 Barbarea	o +	1 vulgaris	—	
	4 Nasturtium	o	1 officinale	—	(?)
		o	3 palustre	—	
		o	4 amphibium	—	
	5 Arabis	o +	5 Thaliana	—	
	6 Cardamine		1 amara		
		o +	2 pratensis	—	

			3 impatiens (?)	— (?)
	●	+	4 hirsuta	—
8 Hesperis			1 *matronalis*	
9 Sisymbrium	o	+	1 officinale	—
10 Alliaria	o	+	1 officinalis	—
12 Brassica	o	+	5 campestris	—
	o	+	7 Sinapistrum	—
13 Cochlearia			1 *Armoracia*	
15 Draba	o	+	5 verna	—
19 Teesdalia	o	+	1 nudicaulis	—
20 Iberis			1 amara (?)	
22 Capsella		+	1 Bursa-pastoris	—
23 Lepidium			1 campestre	
24 Senebiera			1 Coronopus	
28 Raphanus			1 Raphanistrum	

VII. MIGNIONETTE FAMILY.

1 Reseda			1 Luteola	

IX. VIOLET FAMILY.

1 Viola		+	2 odorata	—
	o		3 hirta	—
	o	+	4 canina	—
	o	+	5 tricolor, var. *a*, *b*.	—

X. MILKWORT FAMILY.

1 Polygala	o		1 vulgaris	—

XII. PINK FAMILY.

2 Saponaria			1 *officinalis*	
4 Lychnis		+	1 vespertina	—
	o		2 diurna	—
			3 Githago	
			4 Flos-caculi	—
5 Sagina			1 procumbens	
7 Arenaria			3 tenuifolia	
	o		5 serpyllifolia	—
	o	+	7 trinervis	—
10 Cerastium		+	1 vulgatum, var. *a*, *b*.	—
11 Stellaria	o		1 aquatica	—
	o	+	3 media	—
			4 uliginosa	
	o		5 graminea	—
	o	+	7 Holostea	—

	12 Spergularia o	1 rubra	—	Lower Hill Morton Road
19.	13 Spergula +	1 arvensis	—	near Dunchurch & Clifton.

XIII. PURSLANE FAMILY.

2 Montia o		1 fontana	—

XVI. HYPERICUM FAMILY.

1 Hypericum ●		3 perforatum	—
		4 dubium	—
		5 quadrangulum	—
		6 humifusum	—
		8 pulchrum	
		9 hirsutum	

XVII. FLAX FAMILY.

1 Linum		1 *usitatissimum*	
		2 perenne	
		4 catharticum	—
2 Radiola		1 millegrana	

XVIII. MALLOW FAMILY.

2 Malva	o	1 rotundifolia	—
		2 sylvestris	—
	o	3 moschata	—

XIX. LIME FAMILY.

1 Tilia		*intermedia* (L.C.)	

XX. GERANIUM FAMILY.

	1 Geranium		2 *phæum*	
			4 pratense	—
V. 17.		● +	6 Robertianum	—
		+	7 lucidum	—
		+	8 molle	—
			9 pusillum	
			11 dissectum	—
	3 Oxalis		1 Acetosella	

XXI. MAPLE FAMILY.

1 Acer		1 campestre	—
	o	2 *Pseudo-platanus*	—

XXIII. BUCKTHORN FAMILY.

1 Rhamnus		2 Frangula	

XXIV. PEA-FLOWER FAMILY.

1 Ulex	o +	1 europæus	—

	2 Genista	3 anglica
	3 Sarothamnus	1 scoparius
	4 Ononis	1 arvensis, var. antiquorum (L.C.)
	5 Medicago	2 *sativa*
		3 lupulina
	6 Melilotus	1 officinalis
	8 Trifolium	2 (arvense)
		+ 5 pratense
		17 repens
		18 agrarium (procumbens, L.C.)
		+ 19 procumbens (minus, L.C.)
	9 Lotus	1 corniculatus, var. *a*, *b*, *d.*
	14 Ornithopus	1 perpusillus
V.25.	17 Vicia	+ 1 hirsuta
		2 tetrasperma
		3 Cracca
V.25.		+ 6 sepium
		+ 8 sativa
	18 Lathyrus	4 pratensis
		9 (macrorrhizus), (Orobus, L.C.)

XXIV. ROSE FAMILY.

	1 Prunus	+ 1 communis, var. spinosa, insititia, and *domestica.*
		+ 2 Cerasus
	2 Spiræa	1 Ulmaria
V.17.	4 Geum	+ 1 urbanum
		2 (rivale)
	5 Rubus	1 idæus
		2 fruticosus, var. *a*, *b*, *c*, *d.* *
		3 cæsius
	6 Fragaria	+ 1 vesca
	7 Potentilla	1 Fragariastrum
		2 Reptans
V.17		+ 3 Tormentilla
		7 anserina
	9 Alchemilla	1 vulgaris
		3 arvensis
	10 Sanguisorba	1 officinalis
	11 Poterium	1 Sanguisorba
	12 Agrimonia	1 Eupatoria

---

* Mr. Bloxam records 16 of the 45 species of Prof. Babington.

	13 Rosa	1 pimpinellifolia, (spinosissima, L. C.)
		2 villosa (tomentosa, L. C.)
		3 rubiginosa (micrantha, L.C.)
		o 4 canina
		5 arvensis
.17.	14 Pyrus	o + 2 Malus
		/ 5 Aucuparia
.17.	15 Cratægus	+ 1 Oxyacantha

XXVI. ŒNOTHERA FAMILY.

1 Epilobium	2 hirsutum
	o 4 montanum
	6 tetragonum
	7 palustre
4 Circæa	1 lutetiana
5 Myriophyllum	1 spicatum

XXVII. LYTHRUM FAMILY.

1 Lythrum	1 Salicaria

XXVIII. GOURD FAMILY.

1 Bryonia	1 dioica
3 Sedum	7 acre
	9 rupestre, var. reflexum (L.C.)
4 Sempervivum	1 *tectorum*

XXXII RIBES FAMILY.

.26.	1 Ribes	+ 1 *Grossularia* Bilton. Causton. Hill Morton La.
		2 rubrum

XXXIII SAXIFRAGE FAMILY.

1 Saxifraga	+ 6 granulosa
	+ 9 tridactylites
	12 *umbrosa*

XXXIV UMBELLATÆ FAMILY.

1 Hydrocotyle	1 vulgaris
2 Sanicula	1 europæa
7 Heliosciadium	1 nodiflorum, and var. repens
8 Sison	1 amomum
11 Ægopodium	1 Podagria
13 Sium o	2 Angustifolium
14 Pimpinella	1 Saxifraga
	1 fistulosa
16 Œnanthe	4 Phellandrium

	17 Œthusa •		1 Cynapium	—
	21 Silaus		1 pratensis	
	24 Angelica o		1 sylvestris	—
	26 Pastinaca		1 sativa	
	27 Heracleum o		1 sphondylium	—
V. 19.	29 Scandix o	+	1 Pecten	—
V. 17.	31 Bunium o	+	1 flexuosum	—
	32 Chœrophyllum		1 temulum	
	o	+	2 sylvestre	—
			3 Anthriscus	
	33 Caucalis		1 nodosa	
			2 Anthriscus	—
	34 Daucus		1 Carota	
	35 Conium		1 maculatum	

XXXIII. ARALIA FAMILY.

1 Hedera	1 Helix

XXXV. CORNEL FAMILY.

1 Cornus	1 sanguinea

XXXVI. HONEYSUCKLE FAMILY.

2 Sambucus o	1 nigra	—
3 Viburnum	1 Lantana	
	2 Opulus	
4 Lonicera	1 Periclymenum	—

XXXVII. STELLATE TRIBE.

2 Galium o	+	1 Cruciata	—
•		2 verum	—
o		3 palustre	—
o		5 saxatile	—
o		6 Mollugo	—
o		7 Aparine	—
3 Asperula		1 odorata	
4 Sherardia	+	1 arvensis	—

XXXVIII. VALERIAN FAMILY.

?.17.	2 Valeriana	+	1 dioica	Field near Lower Hill Morlall
			2 officinalis	
	3 Valerianella		1 olitoria	
			4 dentata	

XLIII. TEASEL FAMILY.

1 Dipsacus	1 sylvestris —
2 Scabiosa o	1 succisa —
	2 arvensis

XL. COMPOSITE FAMILY.

2 Tussilago o +	1 Farfara —
o +	2 Petasites +
6 Solidago	1 virgaurea
7 Inula	4 dysenterica
	5 *Pulicaria*
8 Bellis o +	1 perennis —
24. o 9 Chrysanthemum +	1 Leucanthemum —
	2 segetum —
	3 Parthenium
	4 inodorum
10 Matricaria +	1 Camomilla —
11 Anthemis	1 Cotula
12 Achillea	1 Ptarmica —
o	2 Millefolium —
14 Tanacetum o	1 vulgare —
15 Artemisia	1 vulgaris
16 Gnaphalium o	6 Uliginosum —
	7 germanicum
17 Senecio o +	1 vulgaris —
	3 sylvaticus
	5 aquaticus
o	6 Jacobæa —
	7 erucæfolius —
19 Bidens	1 cernua —
	2 tripartita
21 Arctium	1 Lappa —
22 Servatula	1 tinctoria
24 Carduus	1 *Marianus*
	2 nutans
	3 acanthoides
o	5 lanceolatus —
	6 palustris —
o	7 arvensis —
	12 acaulis
27 Centaurea o	1 nigra —
	3 Cyanus
28 Tragopogon	1 pratense —

29 Helminthia	1 echioides
30 Picris	1 (hieracioides)
31 Lenotodon	1 hispidus —
	2 autumnalis
32 Hypochæris	2 radicata
33 Lactuca	1 (muralis)
	2 (scariola), var. virosa
34 Sonchus o	1 arvensis —
	3 oleraceus —
35 Taraxicum • +	1 Dens-Leonis ✓
36 Crepis	3 virens —
37 Hieracium o	1 Pilosella ✓
	3 murorum, var. sylvaticum
	5 umbellatum
	6 sabaudum (boreale, L. C.) ✓
38 Cichorium o	1 Intybus
40 Lapsana	1 communis — ✓

XLI. CAMPANULA FAMILY.

2 Jasione	1 montana
4 Campanula	1 latifolia
	2 (patula)
	3 rotundifolia ✓
	4 hybrida

XLII. HEATH FAMILY.

7 Erica o	1 vulgaris — ✓

XLIII. PRIMROSE FAMILY.

2 Primula o +	1 vulgaris, var. a, b, c. ✓
4 Lysimachia	3 nummularia —
	4 (nemorum)
7 Anagallis	1 arvensis —

XLV. HOLLY FAMILY.

1 Ilex	1 Aquifolium

XLVI. JESSAMINE FAMILY.

1 Fraxinus +	1 excelsior
2 Ligustrum	1 vulgare — ✓

XLVIII. GENTIAN FAMILY.

1 Erythrœa	1 Centaurium
5 Menyanthes	1 trifoliata

L. CONVOLVULUS FAMILY.

1 Convolvulus	1 arvensis
	2 sepium
2 Cuscuta	3 Epithymum

LI. BORAGE FAMILY.

1 Echium	1 vulgare
5 Myosotis	1 palustris, and var. cœspitosa
	+ 3 arvensis
	+ 4 collina
V.17.	+ 5 versicolor Lower Hill Morton.
7 Lycopsis	1 arvensis
8 Symphytum	1 officinale
9 Borago	1 *officinalis*

LII. SOLANUM FAMILY.

1 Datura	1 *Stramonium*
3 Solanum	1 Dulcamara

LIII. SCROPHULARIA FAMILY.

1 Verbascum	1 Thapsus
2 Antirrhinum	1 *Majus*
3 Linaria	1 vulgaris
	6 *Cymbalaria*
4 Scrophularia	1 nodosa
	2 aquatica
8 Digitalis	1 purpurea
17. 9 Veronica	+ 4 serpyllifolia
	5 officinalis
	6 Anagallis
	7 Beccabunga
	+ 10 Chamœdrys
	+ 11 hederæfolia
	+ 12 agrestis, and var. polita
	+ 13 Buxbaumii
	+ 14 arvensis
10 Bartsia	3 Odontites
11 Euphrasia	1 officinalis
12 Rhinanthus	11 Crista-Galli
13 Pedicularis	2 sylvatica
14 Melampyrum	3 (pratense) ?

LV. LABIATE FAMILY.

1 Salvia	2 verbenaca

	2 Lycopus	1 europæus —	
	3 Mentha	3 viridis	
	o	5 aquatica —	
		6 sativa	
	o	7 arvensis —	
	4 Thymus	1 Serpyllum —	
	6 Calamintha	3 Clinopodium	
	7 Nepeta o	+ 1 Glechoma —	
	8 Prunella	1 vulgaris —	
	9 Scutellaria o	1 galericulata —	
	12 Stachys	1 Betonica	
		3 sylvatica —	
	o	4 palustris —	
	13 Galeopsis	1 Ladanum -	
		3 Tetrahit —	
	14 Ballota	1 nigra	
	16 Lamium o	1 amplexicaule —	
	o	+ 2 purpureum, and var. incisum —	
	o	+ 3 album —	
V. 19th	o	+ 4 *maculatum* —	Dunchurch Road.
		5 Galeobdolou	
	17 Teucrium	1 Scorodonia	
V. 22.	18 Ajuga o	+ 1 reptans —	

LVI. VERVEIN FAMILY.

1 Verbena	1 officinalis

LVIII. PLANTAIN FAMILY.

1 Plantago	1 major —
	2 media —
	+ 3 lanceolata —

LIX. PARONRCHIA FAMILY.

4 Schleranthus	1 annuus

LX. GOOSEFOOT FAMILY.

4 Chenopodium	3 album —
	5 rubrum
o	9 Bonus Henricus —
6 Atriplex o	4 patula, var. *a*, *c*. —

LXI. POLYGONUM FAMILY.

1 Rumex	2 crispus —
	3 obtusifolius
	4 Hydrolapathum

5 conglomeratus —
6 sanguineus
9 Acetosa —
10 Acetosella —
3 Polygonum o 1 aviculare —
2 Convolvulus —
7 amphibium —
8 Persicaria —
10 Hydropiper —

LXVI. SPURGE FAMILY.

1 Euphorbia o + 2 Helioscopia —
6 Peplus —
7 exigua
2 Mercurialis 1 perennis
3 Buxus o + 1 *sempervirens*

LXVIII. CALLITRICHE FAMILY.

1 Callitriche o + 1 aquatica

LXIX. NETTLE FAMILY.

1 Urtica o 1 urens —
o 3 dioica —
2 Parietaria 1 (officinalis)
3 Humulus 1 Lupulus

LXX. ELM FAMILY.

1 Ulmus 1 montana
2 campestris —

LXXI. CATKIN FAMILY.

2 Alnus + 1 glutinosa —
3 Betula + 1 alba —
4 Carpinus 1 Betulus
5 Corylus + 1 Avellana —
6 Fagus 1 sylvatica
7 Quercus 1 Robur, *a*, pedunculata —
8 Salix 3 alba (vitellina) —
o 4 amygdalina (triandra, Hoffmanniana) —
5 viminalis —
+ 6 Caprea —
+ 7 aurita —
9 phylicifolia (nigricans)
9 Populus 1 alba
3 *nigra* —

LXXIII. PINE FAMILY.

1 Pinus	1 *sylvestris*	
2 Juniperus	1 *communis*	
3 Taxus	1 *baccata*	

Class II.—Monocotyledons.

LXXIV. BULRUSH FAMILY.

1 Typha	1 latifolia	
	2 angustifolia	
2 Sparganium o	1 ramosum	—
	2 simplex	

LXXV. ARUM FAMILY.

1 Arum o	+ 1 maculatum	

LXXVI. DUCKWEED FAMILY.

1 Lemna	1 trisulca	
	+ 2 minor	
	3 gibba	

LXXVII. NAIAD FAMILY.

5 Potamogeton	1 natans	
	3 lucens	
	5 perfoliatus	
	6 crispus	
	7 densus	
	8 pusillus, and var. rosteræfolius	
	- 9 pectinatus	

LXXVIII. ALISMA FAMILY.

1 Butomus	1 umbellatus	
2 Sagittaria	1 sagittifolia	—
3 Alisma o	1 Plantago	—
6 Triglochin	1 palustre	

LXXIX. HYDROCHARIS FAMILY.

1 Elodea o	+ 1 *canadensis*	—

LXXX. ORCHID FAMILY.

4 Epipactis o	1 latifolia	—
6 Listera o	1 ovata	—
7 Neottia	1 Nidus Avis	
9 Orchis o	+ 1 Morio	—
	2 mascula	
	6 maculata	—
	7 latifolia	—
12 Habenaria	1 (bifolia)	

LXXXI. IRIS FAMILY.

1 Iris o	1 Pseudacorus —

LXXXII. AMARYLLIS FAMILY.

1 Narcissus	1 *Pseudonarcissus*

LXXXIII. YAM FAMILY.

1 Tamus	1 communis —

LXXXIV. LILY FAMILY.

2 Polygonatum	2 (multiflorum)
11 Ornithogalum	1 *Umbellatum*
12 Scilla o	3 nutans —

LXXXV. RUSH FAMILY.

1 Juncus o	1 communis, var. effusus, conglomeratus —
	2 articulatus, var. lamprocarpus
2 Luzula o +	4 campestris —

LXXXVI. SEDGE FAMILY.

6 Scirpus	2 palustris
o	12 lacustris —
o	14 sylvaticus —
9 Carex	2 pulicaris
	5 leporina
	10 remota
	13 vulpina —
	14 muricata
	17 incurva
o	20 acuta —
	26 præcox
	41 sylvatica
	47 paludosa, and var. (riparia)

LXXXVI. GRASS FAMILY.

5 Anthoxanthum	1 odoratum
6 Phalaris	1 canariensis
7 Digraphis	1 arundinacea
8 Phleum	1 pratense
9 Alopecurus	1 agrestis
15. o +	2 pratensis —
	3 geniculatus
13 Agrostis	1 alba
17 Aira	1 cæspitosa
	2 flexuosa

18 Avena		1 fatua	
		2 pratensis, and var. pubescens	
		3 flavescens	
19 Arrhenatherum		1 avenaceum	—
20 Holcus		1 lanatus	— (?)
26 Hordeum	o	1 pratense	—
		2 murinum	
27 Triticum		1 repens	
28 Lolium		1 perenne	—
30 Bromus		2 asper	
		3 sterilis	
		4 arvensis, *b.*	— (?)
		7 giganteus	
31 Festuca		1 ovina, *a*, *b.*	
		2 elatior, *b. c.*	
		3 sylvatica	
32 Dactylis	o	1 glomerata	—
33 Cynosurus		1 cristatus	—
34 Briza		1 media	
35 Poa	o	1 aquatica	—
		2 fluitans	
	+	8 annua	—
		10 pratensis	
		11 trivialis	
42 Arundo	o	1 Phragmites	—

Class III.—Cryptogams.

LXXXIX. EQUISETUM FAMILY.

1 Equisetum	o	2 arvense	—
	o	4 palustre	—
	o	5 limosum	—
		7 hyemale	

XC. FERN FAMILY.

4 Polypodium	+	1 vulgare	—
7 Aspidium		2 aculeatum, and var. lobatum	—
	+	5 Filix-mas	—
		7 spinulosum (dilatatum)	—
8 Asplenium		1 Filix-fœmina	—
9 Scolopendrium		1 vulgare	
11 Blechnum		1 spicant	
12 Pteris		1 aquilina	—

— 250

+ 50.

25

ADDENDA, 1866-67,

TO F. E. KITCHENER'S LIST OF FLOWERING PLANTS AND FERNS FOUND AT RUGBY.

The numbers and names of species in this List still refer to the 1865 *edition of Bentham's Flora. The numbers will be found somewhat changed in the new edition of* 1867.

B = *from Mr. Bloxam's List made some years ago;* K = *found by F. E. Kitchener;* R *and* L = *H. C. Reader and H. M. Larden.*

Fam.	Gen.			By whom recorded.
I.	6	Ranunculus	12 philonotis (remove ?)	
II.		BARBERRY FAMILY.		
	1	Berberis	1 vulgaris	W. C. Eyton, & W. MacGregor
V.	1	Corydalis	1 *lutea*	R. and L.
VI.	1	Barbarea	1 vulgaris (and præcox)	B.
	11	Erysimum	1 cheiranthoides	R.
	14	Alyssum	1 *calycinum*	R. and L.
	18	Thlaspi	1 arvense	R. and L.
	20	Iberis	1 amara (remove ?)	
XII.	3	Silene	2 inflata	K.
			7 noctiflora	R. and L.
Read	4	Lychnis	4 *for* Floscaculi, *read* Floscuculi	
	5	Sagina	1 procumbens (and apetala)	B.
			2 nodosa	B.
	10	Cerastium	1 vulgatum(and semidecandum)	K.
XIX.	1	Tilia	1 europœa	B.
XX.	2	Erodium	1 cicutarium	R. and L.
XXIII.	1	Rhamnus	1 catharticus	K.
XXIV.	2	Genista	1 tinctoria	B.
	8	Trifolium	1 *incarnatum*	R.
			8 striatum	B.
			16 fragiferum	R. and L.

Fam.	Gen.				By whom recorded.
	10	Anthyllis	1	vulneraria	G. B. Longstaff
	2	Spiræa	2	filipendula	R. and L.
	13	Rosa	4	canina (including canina, tomentella, verticillacantha, urbica, dumalis, dumetorum)	B.
XVI.	1	Epilobium	1	(augustifolium)	R.
			3	parviflorum	L.
	6	Hippuris	1	vulgaris	B.

Between Bryonia *and* Sedum, *insert*

XXIX.		CRASSULA FAMILY.			
XXX.	1	Ribes	4	nigrum	L.
XXXI.	1	Saxifraga	6	*read* granulata	
XXXII.	11	*for* Podagria		*read* Podagraria	
	13	Sium	1	latifolium	B.
	14	Pimpinella	2	magna	B.
Read	16	Œnanthe	1	fistulosa	
	33	Caucalis	1	infesta	R.
	38	Coriandrum	1	*sativum*	K's walking party.
XXXVI.	2	Sambucus	2	ebulus (?)	
XXXVIII.	21	Arctium	1	Lappa(including majus& minus)	B.
Read	22	Serratula		*for* Servatula	
	24	Carduus	4	eriophorus	B.
	27	Centaurea	1	nigra (radiant form)	L
	31	Leontodon	3	hirtus	B.
	34	Sonchus	3	oleraceus (and asper)	B.
	35	*for* Taraxicum		*read* Taraxacum	
XLII.	7	Erica	3	tetralix	H. and R.
XLIV.		PINGUICULA FAMILY.			
	1	Utricularia	1	vulgaris	B.
XLVII.		PERIWINKLE FAMILY.			
	1	Vinca	2	minor	L.
LI.	4	Lithospermum	1	arvense	K.
LII.	3	Solanum	2	nigrum	B.
LIX.		*for* Paronrchia		*read* Paronychia	
LX.	4	Chenopodium	6	urbicum	K.

Fam.	Gen.			By whom recorded.
LXII.	1	Daphne	2 Laureola	R.
LXX.	1	Ulmus	2 campestris (including also suberosa, glabra)	B.
LXXI.	9	Populus	2 tremula	B.
LXXVI.	4	Lemna	4 polyrrhiza	R. and L.
LXXVII.	5	Potamogeton	8 pusillus (including also compressus, and zosteræfolius)	B.
LXXX.	12	Habenaria	1 bifolia (= chlorantha)	
	15	Ophrys	1 apifera	A. E. Stuart.
LXXXV.	1	Juncus	2 glaucus	K.
			5 articulatus, (including acutiflorus, supinus)	
			9 bufonius	L.
	2	Luzula	1 pilosa	B.
LXXXVI.	6	Scirpus	7 setaceus	Mr. Baxter.
	9	Carex	5 leporina (= ovalis, Good)	
			14 muricata (and divulsa)	B.
			19 cæspitosa	B.
			31 hirta	B.
			37 panicea	B.
			40 glauca	K's party.
			17 incurva (to be removed)	
LXXXVI.	13	Agrostis	1 alba (and vulgaris)	B.
	17	Aira	4 præcox	B.
			5 caryophyllea	B.
	20	Holcus	2 mollis	B.
	27	Triticum	2 caninum	B.
	29	Bracypodium	1 sylvaticum	B.
	30	Bromus	4 arvensis, b, c, (and commutatus)	B.
			7 *for* gigantens *read* giganteus	
XC.	8	Asplenium	7 *Adiantum-nigrum*	L.
			8 *Ruta-muraria*	C. Arnold.

RADCLIFFE

[illegible]